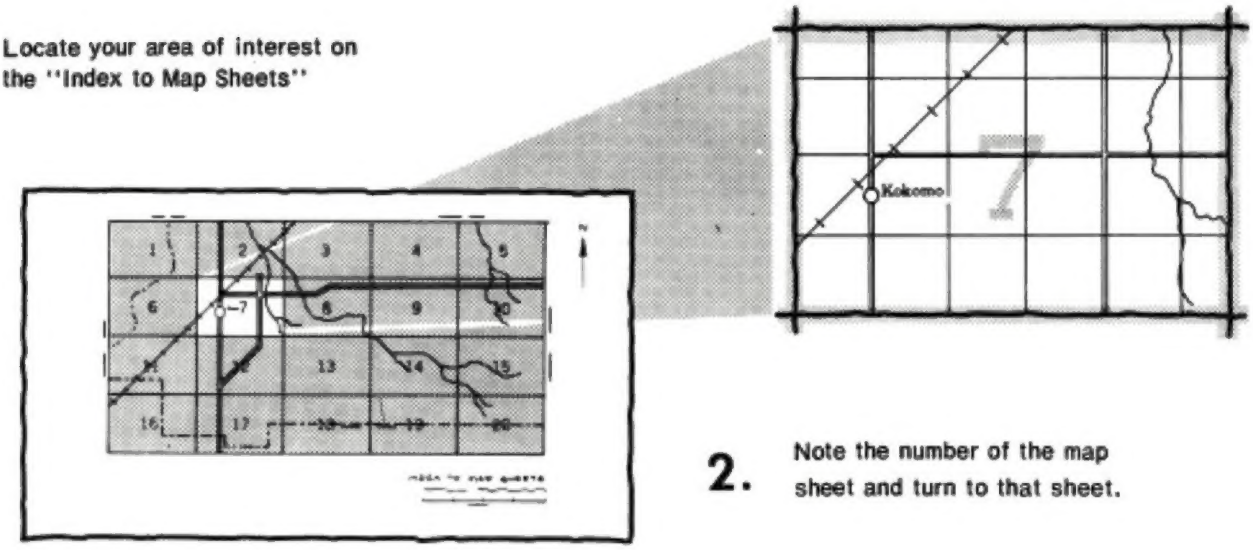
SOIL SURVEY OF
CALLAHAN COUNTY
TEXAS

United States Department of Agriculture, Soil Conservation Service

in cooperation with Texas Agricultural Experiment Station

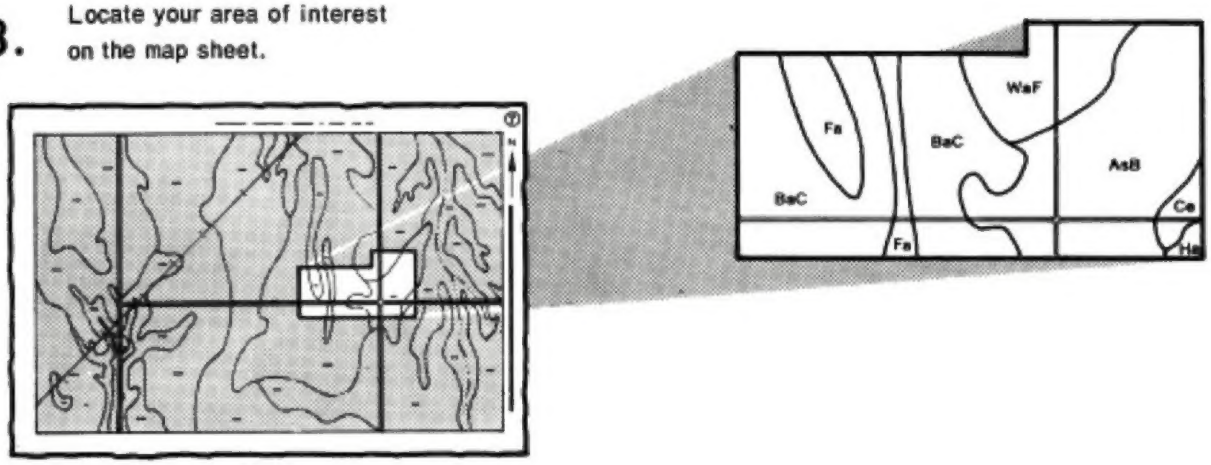
HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"

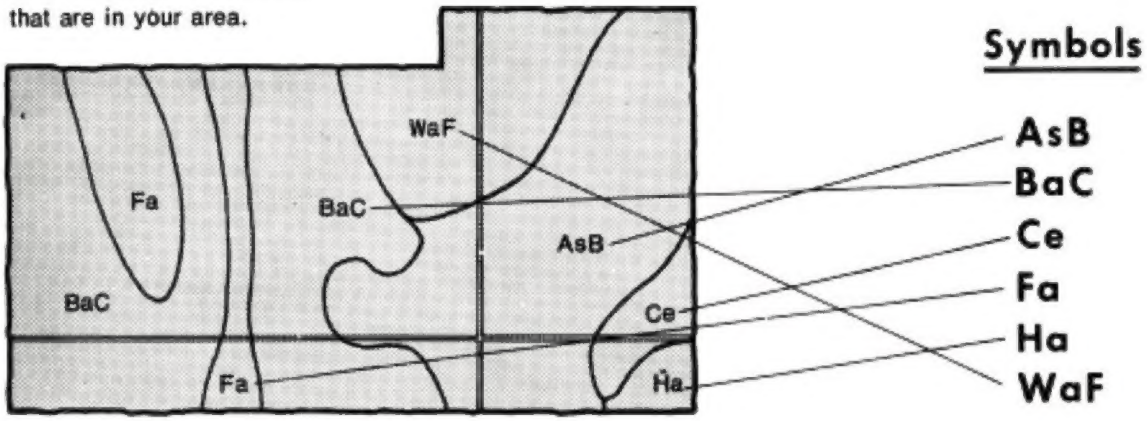


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.

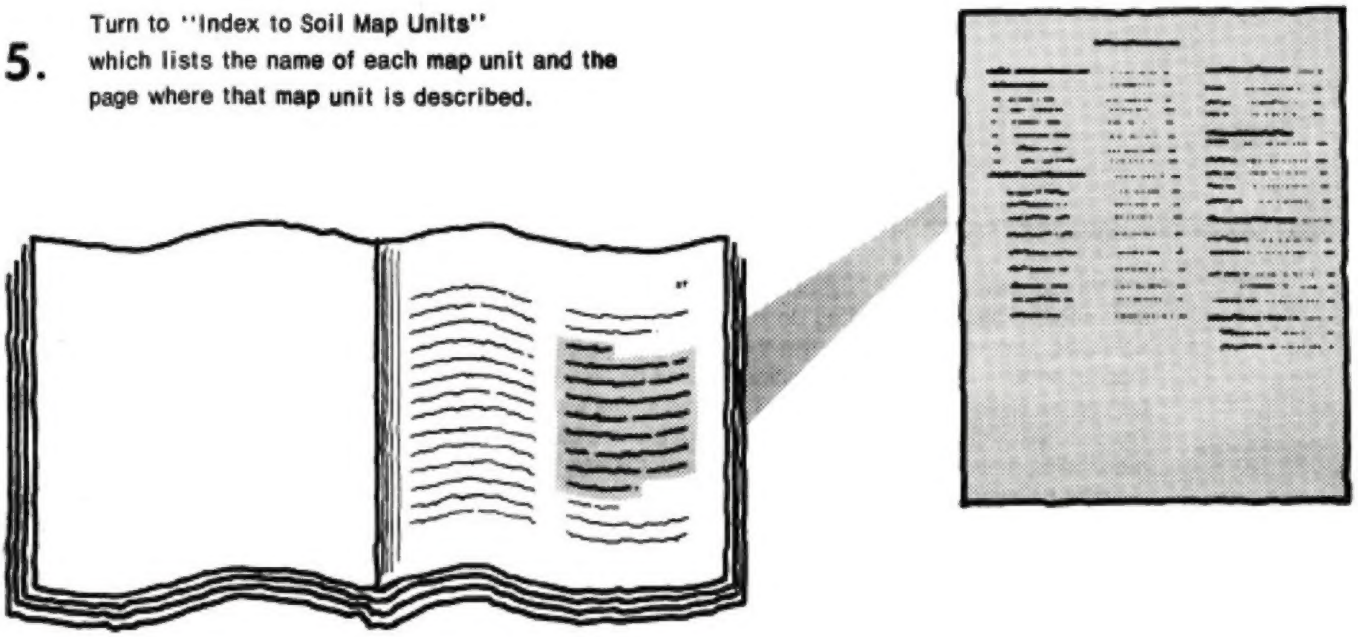


4. List the map unit symbols that are in your area.

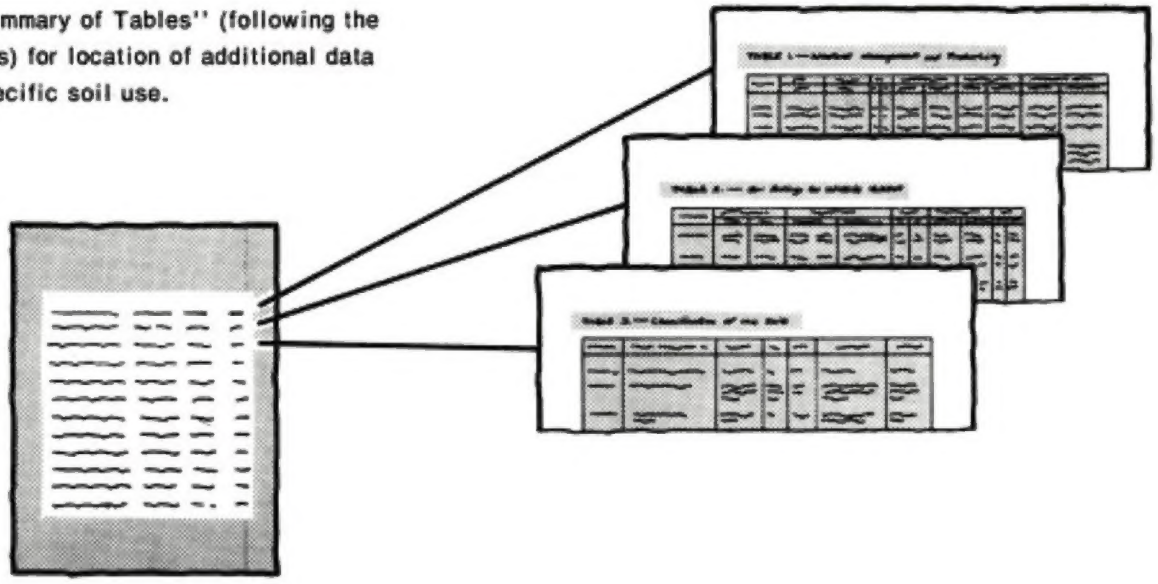


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1965-78. Soil names and descriptions were approved in 1979. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1978. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Central Colorado Soil and Water Conservation District and the Lower Clear Fork of the Brazos Soil and Water Conservation District.

Cover: Typical landscape in an area of rangeland in Callahan County. King Ranch bluestem in Cisco-Hext-Pedernales association, undulating, is in the foreground. West Caddo Peak in Hext-Oplin-Brackett association, hilly, is in the background.

contents

Soil series

Issued August 1981

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summary of tables

foreword

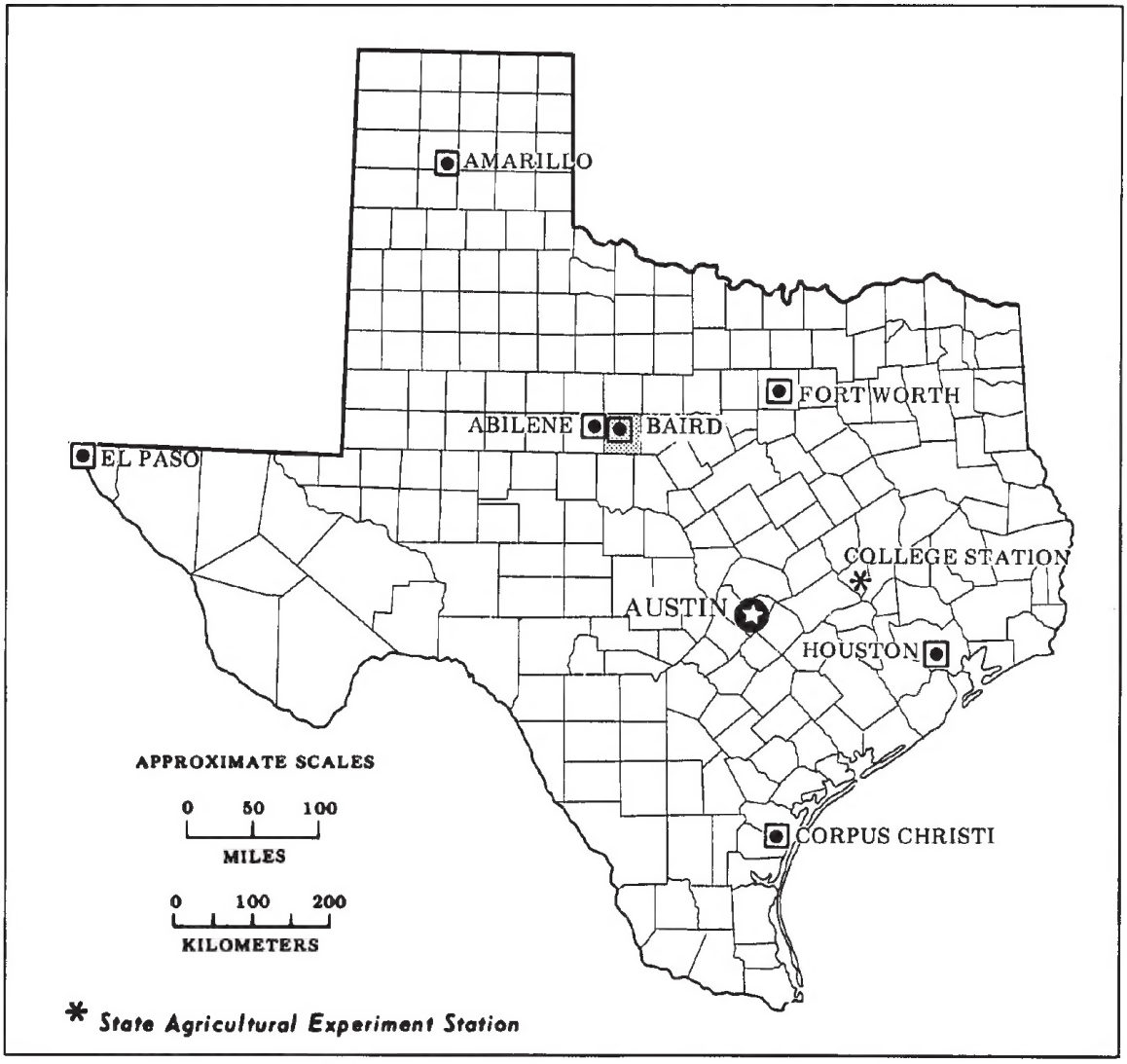
This soil survey contains information that can be used in land-planning programs in Callahan County, Texas. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

George C. Marks
State Conservationist
Soil Conservation Service



Location of Callahan County in Texas.

soil survey of
Callahan County, Texas

By Dennis F. Clower, Soil Conservation Service

Soils surveyed by O. L. Botts, Dennis F. Clower, R. B. Hailey, and Wayburn Mitchell, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service
in cooperation with
Texas Agricultural Experiment Station

CALLAHAN COUNTY is in the northwestern part of central Texas. It has an area of 548,480 acres, or 857 square miles. It is bordered on the north by Shackelford County, on the east by Eastland County, on the south by Brown and Coleman Counties, and on the west by Taylor County. Callahan County is about 30 miles on each of its four sides.

Callahan County is mainly in the Red Rolling Plains and the West Cross Timbers Land Resource Areas. Some minor areas are in the Edwards Plateau and the North Central Prairie. The soils formed under a savannah of grasses and scattered post oak trees. The soils that formed under grass are dark colored and loamy or clayey, and the soils that formed under post oak are mainly light colored and loamy or sandy.

The topography is undulating to hilly and generally slopes to the east. Elevation is mainly between 1,500 and 2,100 feet. Average rainfall ranges from about 24 inches in the western part of the county to about 26 inches in the eastern part.

Callahan County is mostly used for range. About 75 percent is rangeland; 20 percent, cropland; 3 percent, pastureland; and 2 percent, urban land, farmsteads, roads, or water (*4*). Raising beef cattle is the principal ranching enterprise. Wheat, oats, peanuts, forage or grain sorghum, and cotton are the main cultivated crops.

Descriptions, names, and delineations of soils in this soil survey do not fully agree with those on soil maps for adjacent counties. Differences are the result of better knowledge of soils, modifications in series concepts, intensity of mapping, or the extent of soils within the survey.

general nature of the survey area

This section contains general information about Callahan County. It briefly discusses climate, settlement and population, ranching and farming, and natural resources.

climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Putnam, Texas in the period 1964 to 1976. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 47° F, and the average daily minimum temperature is 35°. The lowest temperature on record, which occurred at Putnam on January 12, 1973, is 3°. In summer the average temperature is 81°, and the average daily maximum temperature is 94°. The highest recorded temperature, which occurred on August 6, 1964, is 110°.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50° F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 25.94 inches. Of this, 16 inches, or 60 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 13 inches. The heaviest 1-day rainfall during the period of record was 4.51 inches at Putnam on May 29, 1971. Thunderstorms occur on about 40 days each year, and most occur in May.

Average seasonal snowfall is 6 inches. The greatest snow depth at any one time during the period of record was 8 inches. On an average of 3 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 50 percent. Humidity is higher at night, and the average at dawn is about 70 percent. The sun shines 80 percent of the time possible in summer and 70 percent in winter. The prevailing wind is from the south-southwest. Average windspeed is highest, 14 miles per hour, in March.

Duststorms occur occasionally in spring when strong, dry winds blow over unprotected soils. Tornadoes and severe thunderstorms, some with hail, occur occasionally. These storms are local and of short duration, and the pattern of damage is variable and spotty.

settlement and population

Callahan County, named for James H. Callahan of the Texas Rangers, was organized in 1858 from parts of Bexar, Bosque, and Travis Counties. Settlers began establishing their homes in this area in 1874. Game, water, and good soil for farming and ranching were abundant. The county was formally organized on July 30, 1877, and the village of Callahan City became the temporary county seat.

The nearby town of Belle Plain won a spirited election on December 9, 1877, for the permanent county seat. In 1881, Belle Plain College was founded by the Methodist Church. Enrollment reached a peak of 300, and students attended from throughout the region. After the town lost both the county seat and many citizens to Baird in 1883, the college eventually closed.

Other towns in Callahan County include Clyde, Cross Plains, Cottonwood, Eula, Putnam, and Oplin.

The county had a population of 3,453 in 1880. Population increased until about 1910, reaching 12,973. The increase was mainly the result of agricultural growth. By 1960 the population had decreased to 7,929. In 1975 it was estimated at 9,238. The population of Callahan County continues to increase. Many people live in Callahan County and commute to work in nearby Abilene.

ranching and farming

Cattle ranching was the first agricultural enterprise in the county. The availability of inexpensive land and nutritious grasses made the area especially suitable for raising livestock. Today, cattle ranching is still the main enterprise. Horses, swine, goats, and sheep are also raised in the county.

About 75 percent of the county is used as grazing lands (*4*). Livestock operations consist mainly of the cow-calf type. Cattle graze mostly on native rangeland; however, the acreage of improved tame pastureland is increasing rapidly, especially on deep, loamy and sandy soils.

Cropland makes up approximately 20 percent of the county (*4*). Wheat, peanuts, forage and grain sorghums, oats, and cotton are the main crops. Wheat and oats are planted early in fall and are grazed by stocker cattle during fall and winter and early in spring. The stocker cattle are generally taken off the wheat in sufficient time to plant a grain crop.

natural resources

The soil is the most important natural resource in the county. Most of the people in the county earn their livings by producing forage for livestock or food and fiber for market and home.

Oil and gas are produced from numerous wells in the county. They provide a major source of income for some landowners and have served as a solid tax base from which public services can be funded.

Water is another natural resource. Lake Clyde and Baird Lake furnish municipal water for the cities of Clyde and Baird. These lakes also provide good recreational facilities. Many flood-retarding structures have been built in the southern part of the county to help prevent flood damage. Most of these lakes are used for recreation and watering of livestock.

Wildlife produced on the farms and ranches provide recreation and a source of income for many residents.

Other natural resources are sand, gravel, and limestone. They are used mainly in road construction.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the

boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

1. Throck-Speck-Lueders

Moderately deep to very shallow, undulating to hilly, stony, cobbly, and loamy soils; on uplands

This map unit has slopes of 1 to 30 percent. Throck soils are undulating to hilly and are on convex side slopes of hills and ridges. Speck soils are on the crest and summit of ridges. The cobbly Lueders soils are on convex ridgetops.

This unit makes up about 47 percent of the county. It is about 30 percent Throck soils, 20 percent Speck soils, 13 percent Lueders soils, and 37 percent other soils.

Typically, the Throck soils have a slightly acid, grayish brown stony clay loam surface layer about 6 inches thick. The subsoil, to a depth of 30 inches, is moderately alkaline, brownish silty clay loam. The underlying layer is brownish shaly silty clay.

Typically, the Speck soils have a moderately alkaline, brown clay loam surface layer about 7 inches thick. The subsoil, to a depth of 18 inches, is moderately alkaline, dark reddish brown clay. Below that is limestone.

Typically, the Lueders soils have a surface layer that is about 14 inches thick. It is moderately alkaline, dark grayish brown cobbly clay loam, grading to very cobbly clay loam in the lower part. Limestone fragments, 1 inch to 10 inches in diameter, cover about 15 percent of the surface. Below that is fractured limestone.

Other soils in this map unit are Bonti, Callahan, Cho, Exray, Frio, Gageby, Leeray, Mereta, Nukrum, Owens, and Rowden soils. The moderately deep Bonti, Callahan, and Rowden soils are gently sloping to hilly and on uplands. The shallow and very shallow Cho, Exray, and Mereta soils are gently sloping to undulating and on uplands. The deep, loamy Frio and Gageby soils are on flood plains. The deep, clayey Leeray and Nukrum soils are gently sloping and on uplands. The shallow, clayey Owens soils are gently sloping to hilly and on uplands.

Most areas of this map unit are too sloping and stony or cobbly for cultivation. These areas are better suited to use as rangeland. Much of the area is open prairie, but some areas are covered with various shrubs and mesquite brush. A few small fields are used for small grain, forage sorghum, or introduced pasture grasses, such as kleingrass and coastal bermudagrass.

The soils in this unit are moderately suited to use as wildlife habitat. They are poorly suited to use as cropland and pastureland because of depth to rock, stones, and cobbles. The limitations for urban and recreation uses are depth to rock, stones, the clayey surface layer in places, and shrink-swell potential.

2. Leeray-Sagerton-Nukrum

Deep, nearly level to gently sloping, clayey and loamy soils; on uplands

This map unit has slopes of 0 to 5 percent. Leeray and Sagerton soils are nearly level to gently sloping, and Nukrum soils are gently sloping.

This unit makes up about 17 percent of this county. It is about 24 percent Leeray soils, 23 percent Sagerton soils, 17 percent Nukrum soils, and 36 percent other soils.

Typically, the Leeray soils are moderately alkaline clay to a depth of 65 inches. They are dark grayish brown in the upper part, grayish brown in the middle part, and brown in the lower part.

Typically, the Sagerton soils have a mildly alkaline, dark brown loam surface layer about 7 inches thick. The subsoil, to a depth of 25 inches, is moderately alkaline, reddish brown clay. From a depth of 25 to 40 inches, it is moderately alkaline, yellowish red clay. From a depth of 40 to 65 inches, it is moderately alkaline, reddish yellow clay loam.

Typically, the Nukrum soils have a surface layer that is moderately alkaline, dark grayish brown clay to a depth of 39 inches. The subsoil, from a depth of 39 to 65 inches, is moderately alkaline, grayish brown clay. The

underlying layer to a depth of 70 inches is pale brown clay.

Other soils in this map unit are Abilene, Frio, Gageby, Rowden, Rowena, and Nuvalde soils. The deep, loamy Abilene, Rowena, and Nuvalde soils are nearly level to gently sloping and on uplands. The deep, loamy Frio and Gageby soils are nearly level and on flood plains. The moderately deep, loamy Rowden soils are gently sloping and on uplands.

Areas of this map unit are used as cropland, pastureland, and rangeland. The soils are well suited to use as pastureland and cropland. If cultivated, the main crops are wheat, forage sorghum, and grain sorghum.

The soils in this unit have limitations for urban and recreation uses. The clayey layers shrink and swell with changes in moisture content. This action causes foundations, dwellings, and streets and roads to crack if they are not properly designed. The moderately slow to very slow permeability causes septic tank systems to fail during rainy seasons if the systems are not properly designed. The clayey surface layer and permeability are limitations for playgrounds and campsites.

3. Pedernales-Cisco-Hext

Deep and moderately deep, gently sloping to undulating, loamy soils; on uplands

This map unit has slopes of 1 to 8 percent. Pedernales and Cisco soils are gently sloping to undulating and are on convex uplands. Hext soils are gently sloping to undulating on the higher crests of ridges and knolls.

This unit makes up about 16 percent of the county. It is about 57 percent Pedernales soils, 25 percent Cisco soils, 7 percent Hext soils, and 11 percent other soils.

Typically, the Pedernales soils have a mildly alkaline, brown fine sandy loam surface layer about 7 inches thick. The subsoil, to a depth of 53 inches, is neutral and moderately alkaline, red sandy clay that grades to sandy loam in the lower part. The underlying layer to a depth of 70 inches is moderately alkaline, reddish yellowish sandy clay loam.

Typically, the Cisco soils have a slightly acid, reddish brown fine sandy loam surface layer about 9 inches thick. The subsoil, to a depth of 49 inches, is slightly acid to moderately alkaline, yellowish red sandy clay loam. The underlying layer to a depth of 65 inches is calcareous, pink sandy clay loam.

Typically, the Hext soils have a moderately alkaline, brown loam surface layer about 6 inches thick. The subsoil, to a depth of 22 inches, is moderately alkaline loam that is brownish in the upper part and pinkish in the lower part. From a depth of 22 to 28 inches, it is grayish loam. Below that is soft sandstone.

Other soils in this map unit are Chaney, Gageby, and Sagerton soils. The deep, loamy Sagerton soils are nearly level to gently sloping and on uplands. The deep, loamy Gageby soils are on flood plains. The deep, sandy, loamy and stony Chaney soils are gently sloping to undulating and on uplands.

The soils in this map unit are used for cultivated crops and as pastureland and rangeland. Most of the soils in this unit are moderately suited to use as cropland and pastureland. Forage sorghum, grain sorghum, and small grain are the main crops. Much of the area is in native post oak trees. Coastal bermudagrass, kleingrass, and weeping lovegrass have good yields during favorable years. Potential is high for wildlife habitat.

Limitations for urban uses are the clayey lower layers and shrinking and swelling with changes in moisture content. These limitations cause foundation problems for dwellings and streets and roads. The soils in this unit have no limitations for recreation uses.

4. Chaney-Demona

Deep, gently sloping, sandy soils on uplands

This map unit has slopes of 1 to 5 percent. It is on broad uplands.

This unit makes up about 10 percent of the county. It is 65 percent Chaney soils, 10 percent Demona soils, and 25 percent other soils.

Typically, the Chaney soils have a loamy fine sand surface layer about 14 inches thick that is brown in the upper part and pink in the lower part. The subsoil, to a depth of 45 inches, is neutral, light yellowish brown sandy clay with red and gray mottles. The underlying layer to a depth of 72 inches is moderately alkaline, light gray sandy clay loam.

Typically, the Demona soils have a brownish loamy fine sand surface layer about 25 inches thick. The subsoil, to a depth of 61 inches, is sandy clay with brown, red, and gray mottles. The underlying layer to a depth of 70 inches is sandy clay loam with white, yellow, and red mottles. These soils are slightly acid in the upper part and moderately alkaline in the lower part.

Other soils in this map unit are Patilo, Cisco, Pedernales, and Chaney soils. The deep, sandy Patilo soils are gently sloping and on uplands. The deep, loamy Cisco and Pedernales soils are gently sloping to undulating and on uplands. The deep, stony, sandy loam Chaney soils are on uplands.

The soils in this unit are used for cultivated crops and as pastureland and rangeland. These soils are well suited to use as pastureland and for cultivated crops, such as peanuts, forage sorghum, and grain sorghum. However, the soils are highly susceptible to soil blowing when cropped. Coastal bermudagrass and lovegrass have good yields during favorable years. Some areas are irrigated. Potential is high for wildlife habitat.

Limitations for most urban uses are the clayey lower layers and shrinking and swelling with changes in moisture content. These limitations cause some foundation problems for dwellings and streets and roads. The slow to moderately slow permeability is a limitation for septic tank systems during rainy seasons. The sandy surface layer is a limitation for recreation uses.

5. Frio-Gageby

Deep, nearly level, loamy soils on flood plains

This map unit has slopes of 0 to 1 percent. It makes up about 7 percent of the county. It is about 51 percent Frio soils, 41 percent Gageby soils, and 8 percent other soils.

Typically, the Frio soils have a moderately alkaline, dark grayish brown clay loam surface layer about 16 inches thick. From a depth of 16 to 27 inches is moderately alkaline, dark brown silty clay. The subsoil from a depth of 27 to 61 inches is moderately alkaline, brownish silty clay loam.

Typically, the Gageby soils have a moderately alkaline, dark grayish brown loam surface layer about 16 inches thick. Below this to a depth of 60 inches is moderately alkaline, brown loam.

Other soils in this unit are areas of Nukrum, Nuvalde, and Sagerton soils on the higher adjoining uplands. A few areas of gravelly soils are in some areas.

The soils in this map unit are used as rangeland, pastureland, and cropland. These soils are well suited to use as pastureland. Areas that are occasionally flooded are well suited to use as cropland. Potential is high for wildlife habitat.

The hazard of flooding is the main limitation for urban and recreation uses.

6. Oplin-Hext-Brackett

Very shallow to moderately deep, undulating to hilly, flaggy, loamy, and gravelly soils; on uplands

This map unit has slopes of 1 to 30 percent. The flaggy Oplin soils are on convex crests of ridges and hills. Hext soils are on mid and lower side slopes. Brackett soils are mainly on the steeper, upper side slopes.

This unit makes up about 3 percent of the county. It is about 35 percent Oplin soils, 25 percent Hext soils, 14 percent Brackett soils, and 26 percent other soils.

Typically, the Oplin soils have a moderately alkaline, brown, flaggy and very flaggy clay loam surface layer about 9 inches thick. Below that is a thick layer of strongly cemented, fractured limestone.

Typically, the Hext soils have a moderately alkaline, light brownish gray loam surface layer about 7 inches thick. Scattered sandstone fragments are on the surface. The subsoil, from a depth of 7 to 24 inches, is moderately alkaline, light gray loam. Below that is weakly cemented sandstone.

Typically, the Brackett soils have a moderately alkaline, pale brown gravelly loam surface layer about 4 inches thick. The next layer, to a depth of 13 inches, is light gray gravelly loam about 9 inches thick. Below that to a depth of 20 inches is white silty shale.

Other soils in this map unit are Cisco, Cho, and Speck soils. The deep, loamy Cisco soils are on foot slopes. The shallow, loamy Cho and Speck soils are gently sloping and on ridgetops.

Because of slope, depth to rock, and stoniness, these soils are used as rangeland and for wildlife habitat. Vegetation consists of tall and mid grasses, forbs, and trees, such as live oak and Texas oak. The soils in this unit are not suited to use as cropland and pastureland.

Limitations for urban and recreation uses are slope, depth to rock, and stoniness.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Cisco fine sandy loam, 1 to 3 percent slopes, is one of several phases in the Cisco series.

Some map units are made up of two or more major soils. These map units are called soil complexes or soil associations.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Bonti-Callahan-Exray complex, 1 to 8 percent slopes, is an example.

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. Owens-Throck association, hilly, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

1—Abilene loam, 0 to 1 percent slopes. This deep, nearly level soil is mainly on upland plains. A few areas are in shallow valleys. Slopes are smooth. Surfaces are slightly concave to plane. Areas are oblong to irregular in shape and range from 10 to 400 acres.

Typically, the surface layer is dark grayish brown loam about 9 inches thick. The subsoil extends to a depth of 32 inches. The upper part is dark brown clay loam to a depth of 21 inches and brown clay loam to a depth of 32 inches. The lower part is pale brown, calcareous loam to a depth of 53 inches. The underlying material is pink, calcareous clay loam to a depth of 80 inches.

This soil is well drained. Runoff is very slow. The permeability is moderately slow, and the available water capacity is high. Natural fertility and organic matter content are high.

Included with this soil in mapping are small areas of Sagerton, Nuvalde, and Rowena soils. In some areas there is a soil similar to the Abilene soil that is noncalcareous to below a depth of 28 inches, and in other areas there is a similar soil in which the subsoil extends to more than 60 inches. Also included are small areas of Abilene clay loam. The included soils make up as much as 20 percent of a mapped area.

This Abilene soil is used mainly for cropland or improved pasture. Oats, wheat, and forage sorghum are the main crops. A few areas are used for rangeland.

This soil is well suited to wheat, oats, grain sorghum, forage sorghum, and cotton. Crop residue left on the

surface helps to conserve moisture and maintain tilth and productivity.

This soil is well suited to pastureland. Improved pasture grasses, such as kleingrass, coastal bermudagrass, King Ranch bluestem, and weeping lovegrass, grow well on this soil.

This soil is favored for grazing because of the smooth topography and good forage production. The potential rangeland plant community is a short and mid grass prairie. The composition, by weight, is about 90 percent grasses, 10 percent forbs, and traces of woody plants.

The predominant plants are sideoats grama, 25 percent; vine-mesquite, 15 percent; silver bluestem, 10 percent; Arizona cottontop, 10 percent; buffalograss, 10 percent; Texas needlegrass, 10 percent; western wheatgrass, 5 percent; and white tridens, 5 percent. Forbs, such as Englemann-daisy, heath aster, bundleflower, and catclaw sensitivebrier, make up 10 percent. There is a trace of such woody plants as elm and hackberry.

Sideoats grama, vine-mesquite, Arizona cottontop, and western wheatgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, mainly buffalograss, silver bluestem, Texas needlegrass, and dropseed. If heavy grazing continues, the less preferred plants, with the exception of Texas needlegrass and buffalograss, also decline, and threeawn, hairy tridens, Texas grama, other forbs, mesquite, tasajillo, and pricklypear invade. Mesquite continues to increase, along with lotebush and pricklypear.

This soil provides fair nesting areas for doves, quail, and songbirds. An absence of woody plants for food and cover reduces the value of this soil as habitat for wildlife.

The main limitations of this soil for most urban and recreation uses are shrinking and swelling with changes in moisture content, low strength, and corrosivity to uncoated steel.

This soil is in capability subclass IIc and in the Clay Loam range site.

2—Abilene loam, 1 to 3 percent slopes. This deep, gently sloping soil is on uplands in shallow valleys. Slopes are smooth and average about 2 percent. Surfaces are slightly concave to plane. Areas are oblong to irregular in shape and range from 10 to 300 acres.

Typically, the surface layer is dark brown loam about 10 inches thick. The subsoil extends to a depth of 32 inches. It is dark brown clay to a depth of 24 inches, brown clay loam to a depth of 42 inches, and very pale brown silty clay loam that contains accumulations of calcium carbonate to a depth of 52 inches. The underlying material is pink, calcareous clay loam to a depth of 80 inches.

This soil is well drained. Runoff is slow. Permeability is moderately slow, and the available water capacity is high. Natural fertility and organic matter content are high.

Included with this soil in mapping are areas of Rowena and Sagerton soils. In some areas there is a soil similar to the Abilene soil that is noncalcareous to below a depth of 28 inches, and in other areas there is a similar soil in which the subsoil extends to more than 60 inches. These soils make up as much as 20 percent of a mapped area.

This Abilene soil is used mainly for cropland or improved pasture. Oats, wheat, and forage sorghum are the main crops. A few areas are used for rangeland.

This soil is well suited to oats and wheat and is moderately suited to grain sorghum, forage sorghum, and cotton. Terracing and contour farming help to control water erosion. Crop residue left on the surface helps to conserve moisture and maintain tilth and productivity.

This soil is moderately suited to pastureland. Improved grasses, such as kleingrass, coastal bermudagrass, King Ranch bluestem, and weeping lovegrass, are suited to this soil.

This soil is favored for grazing because of the smooth topography and good forage production. The potential rangeland plant community is a short and mid grass prairie. The composition, by weight, is about 90 percent grasses, 10 percent forbs, and traces of woody plants.

The predominant plants are sideoats grama, 25 percent; vine-mesquite, 15 percent; silver bluestem, 10 percent; Arizona cottontop, 10 percent; buffalograss, 10 percent; Texas needlegrass, 10 percent; western wheatgrass, 5 percent; and white tridens, 5 percent. Forbs, such as Engelmann-daisy, heath aster, bundleflower, and catclaw sensitivebrier, make up 10 percent. There is a trace of such woody plants as elm and hackberry.

Sideoats grama, vine-mesquite, Arizona cottontop, and western wheatgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, mainly buffalograss, silver bluestem, Texas needlegrass, and dropseed. If heavy grazing continues, the less preferred plants, with the exception of Texas needlegrass and buffalograss, also decline, and threeawn, hairy tridens, Texas grama, other forbs, mesquite, tasajillo, and pricklypear invade. Mesquite continues to increase, along with lotebush and pricklypear.

This soil provides only fair nesting areas for doves, quail, and songbirds because of the absence of woody plants.

The main limitations of this soil for most urban and recreation uses are shrinking and swelling with changes in moisture content, low strength, and corrosivity to uncoated steel.

This soil is in capability subclass IIe and in the Clay Loam range site.

3—Bontl fine sandy loam, 1 to 3 percent slopes. This moderately deep, gently sloping soil is on uplands, mainly along slightly convex ridges. Slopes are smooth and average about 2 percent. Areas are irregularly shaped and range from 10 to over 100 acres.

Typically, the surface layer is neutral, brown fine sandy loam about 8 inches thick. The subsoil extends to a depth of 30 inches. The upper part to a depth of 16 inches is medium acid, reddish brown sandy clay and the lower part is medium acid, yellowish red clay loam. This layer rests abruptly on strongly cemented sandstone.

This soil is well drained. Runoff is medium. The permeability is moderately slow, and the available water capacity is medium. Natural fertility and organic matter content are moderately low.

Included with some areas of this soil in mapping are small areas of a soil that is similar to the Bonti soil but is less than 20 inches thick over sandstone. This soil is near the edges of ridgetops. Also included are small areas of Callahan soils and a few areas of Pedernales soils on foot slopes. The included soils make up as much as 20 percent of a mapped area.

Although this Bonti soil can be cultivated, it is used mainly for rangeland.

This soil is moderately suited to wheat, oats, and grain sorghum. Crop residue left on the surface helps to prevent water erosion and conserve moisture. Contour farming and terracing are needed in most areas to prevent water erosion. If cuts or excavations exceed about 20 inches, there is a hazard of cutting into strongly cemented sandstone.

This soil is moderately suited to pastureland. Improved grasses, such as kleingrass, weeping lovegrass, King Ranch bluestem, and coastal bermudagrass, are commonly grown.

The potential rangeland plant community is a tall and mid grass, post oak savannah. The composition, by weight, is about 80 percent grasses, 10 percent forbs, and 10 percent woody plants.

The predominant plants are little bluestem, 30 percent; big bluestem, 10 percent; indiangrass, 10 percent; sideoats grama, 10 percent; and silver bluestem, Arizona cottontop, Texas needlegrass, and sand lovegrass, each 5 percent. Forbs, such as prairie-clover, Engelmann-daisy, and Maximilian sunflower, make up 10 percent; and woody plants, such as post oak, blackjack oak, and live oak, make up 10 percent.

Little bluestem, indiangrass, and big bluestem, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as Texas needlegrass, sideoats grama, silver bluestem, Arizona cottontop, dropseed, hooded windmillgrass, catclaw, and post oak. If heavy grazing continues, the less preferred plants, with the exception of post oak, catclaw, and skunkbush sumac, also decline, and threeawn, dropseed, lovegrass, other forbs, mesquite, tasajillo, and lotebush invade. Post oak continues to increase, along with catclaw, lotebush, greenbrier, and skunkbush sumac.

This soil provides good habitat for deer and good nesting areas for quail, doves, turkeys, and songbirds. The woody vegetation attracts fur bearing animals.

The main limitations of this soil for most urban and recreation uses are depth to rock and low strength.

This soil is in capability subclass IIe and in the Tight Sandy Loam range site.

4—Bonti-Callahan-Exray complex, 1 to 8 percent slopes. This complex of gently sloping and sloping, loamy and stony soils (fig. 1) is on upland ridges and in narrow bands on hillsides. Slopes are convex and average about 5 percent. Areas are irregular in shape to elongated and range from 15 to several hundred acres. Sandstone fragments 3 inches to 2 feet across cover 1 to 15 percent of the surface.

The Bonti soil makes up about 35 percent of the complex; Callahan soil, about 30 percent; Exray soil, about 30 percent; and other soils, about 5 percent. These soils are so intricately mixed that separate mapping was not practical at the scale used.

The Bonti soil is on ridgetops and gently sloping areas that are underlain by sandstone. The surface layer is slightly acid, yellowish brown fine sandy loam about 8 inches thick. A few sandstone fragments, 5 to 20 inches across, are on the surface. The subsoil to a depth of 25 inches is slightly acid, reddish brown sandy clay. The underlying material is strongly cemented sandstone. In some areas, as much as 15 percent sandstone fragments of pebble to stone size are on the surface.

Bonti soil is well drained. Runoff is medium. The permeability is moderately slow, and the available water capacity is medium. The root zone is moderately deep.

The Callahan soil is on side slopes of hills and ridges. The surface layer is brown loam about 5 inches thick. The subsoil extends to a depth of 26 inches. It is reddish brown clay to a depth of 13 inches, brown clay to a depth of 20 inches, and brownish yellow clay to a depth of 26 inches. The underlying layer is massive to platy, light gray, shaly clay. Reaction is neutral in the upper part and moderately alkaline in the lower part. In some soils, the surface layer is as much as 15 percent sandstone fragments.

Callahan soil is well drained. Runoff is medium. The permeability is very slow, and the available water capacity is low.

The Exray soil is on narrow ridgetops and around outcrops of sandstone. The surface layer is slightly acid, brown stony fine sandy loam about 6 inches thick. Sandstone fragments, 3 to 15 inches across, cover about 3 percent of the surface. The subsoil to a depth of 15 inches is slightly acid, red sandy clay. The underlying material is cemented sandstone.

Exray soil is well drained. Runoff is rapid. The permeability is moderately slow, and the available water capacity is very low. The root zone is shallow. Natural fertility and organic matter content are low.

Included with this complex in mapping are small areas of Owens soils, areas of a soil that is similar to Exray soils but has a loamy subsoil, and areas of a soil that is similar to Callahan soils but is underlain by shaly clay at a depth of more than 40 inches. In places, there are outcrops of sandstone.

Figure 1.—An area of Bonti-Callahan-Exray complex, 1 to 8 percent slopes.

These Bonti-Callahan-Exray soils are generally too stony or sloping to be used as cropland or pastureland. The few areas of arable soils are so small and irregularly shaped that cultivation is generally impractical. A few small areas are planted to pasture grasses, such as kleingrass. These soils are best suited to native grass.

These soils are favored for grazing because of the smooth topography and good forage production. The potential rangeland plant community on the Bonti and Exray soils is a mid and tall grass post oak savannah. The composition, by weight, is about 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

The predominant plants are sideoats grama, 15 percent; silver bluestem, 15 percent; Texas needlegrass, 15 percent; Arizona cottontop, 10 percent; white tridens, 10 percent; buffalograss, 10 percent; vine-mesquite, 10 percent; and other perennial grasses, 5 percent. Forbs, such as heath aster, bundleflower, and Engelmann-daisy, make up 5 percent; and woody plants, such as hackberry and lotebush, make up 5 percent.

Sideoats grama, Arizona cottontop, and vine-mesquite, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, mainly buffalograss, silver bluestem, Texas needlegrass, and lotebush. If heavy grazing continues, the less preferred plants also decline, and threeawn, Texas grama, red grama, other forbs, tasajillo, pricklypear, and mesquite invade. Mesquite continues to increase, along with lotebush, pricklypear, and tasajillo.

The potential rangeland plant community on the Callahan soil is a mid grass prairie. The composition, by weight, is about 80 percent grasses, 10 percent forbs, and 10 percent woody plants.

The predominant plants are little bluestem, 30 percent; big bluestem, 10 percent; indiangrass, 10 percent; sideoats grama, 10 percent; and silver bluestem, Arizona cottontop, Texas needlegrass, and sand lovegrass, each 5 percent. Forbs, such as prairie-clover, Engelmann-daisy, and Maximilian sunflower, make up 10 percent; and woody plants, such as post oak, blackjack oak, and live oak, make up 10 percent.

Little bluestem, indiangrass, and big bluestem, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as Texas needlegrass, sideoats grama, silver bluestem, Arizona cottontop, dropseed, hooded windmillgrass, catclaw, and post oak. If heavy grazing continues, the less preferred plants, with the exception of post oak, catclaw, and skunkbush sumac, also decline, and threeawn, dropseed, lovegrass, other forbs, mesquite, tasajillo, and lotebush invade. Post oak continues to increase, along with catclaw, lotebush, greenbrier, and skunkbush sumac.

These soils provide habitat for deer and good nesting areas for quail, doves, turkeys, and songbirds. The woody vegetation on the Callahan soil attracts fur bearing animals.

The main limitations of these soils for most urban and recreation uses are depth to bedrock, corrosivity to uncoated steel, low strength, slope, and the stony surface layer.

The soils in this complex are in capability subclass VIs. The Bonti soil is in the Tight Sandy Loam range site, the Callahan soil is in the Claypan Prairie range site, and the Exray soil is in the Sandy Loam range site.

5—Callahan loam, 1 to 3 percent slopes. This moderately deep, gently sloping soil is on uplands. Slopes are smooth and average about 2 percent. Areas are elongated to irregular in shape and range from 10 to several hundred acres.

Typically, the surface layer is moderately alkaline, brown loam about 4 inches thick. The subsoil to a depth of 38 inches is moderately alkaline clay. It is reddish brown in the upper part, yellowish red in the middle part, and brown in the lower part. The underlying material is shaly clay.

This soil is well drained. Runoff is medium. The permeability is very slow, and the available water capacity is low.

Included with some areas of this soil in mapping are small areas of Bonti, Throck, Pedernales, Sagerton, and Nukrum soils. Also included are areas of a soil that is similar to the Callahan soil but has a dark clay loam surface layer, and a soil that is noncalcareous to a depth of more than 28 inches. The included soils make up as much as 20 percent of a mapped area.

This Callahan soil is used for rangeland and cropland.

This soil is moderately suited to wheat, oats, and grain sorghum. Crop residue left on the surface helps to prevent water erosion and conserve moisture. Contour farming and terracing are needed in most areas to prevent water erosion.

This soil is moderately suited to pastureland. Improved grasses, such as kleingrass, weeping lovegrass, King Ranch bluestem, and coastal bermudagrass, are suited.

This soil is favored for grazing because of the smooth topography and good forage production. The potential rangeland plant community is a mid and short grass prairie. The composition, by weight, is about 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

The predominant plants are sideoats grama, 15 percent; silver bluestem, 15 percent; Texas needlegrass, 15 percent; Arizona cottontop, 10 percent; white tridens, 10 percent, buffalograss, 10 percent; vine-mesquite, 10 percent; and other perennial grasses, 5 percent. Forbs, such as heath aster, bundleflower, and Engelmann-daisy, make up 5 percent, and woody plants, such as hackberry and lotebush, make up 5 percent.

Sideoats grama, Arizona cottontop, and vine-mesquite, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, mainly buffalograss, silver bluestem, Texas needlegrass, and lotebush. If heavy grazing continues, the less preferred plants also decline, and threeawn, Texas grama, red grama, other forbs, tasajillo, pricklypear, and mesquite invade. Mesquite continues to increase, along with lotebush, pricklypear, and tasajillo.

This soil provides good nesting areas for doves, quail, and songbirds. An absence of woody plants for food and cover, however, limits use as habitat for wildlife.

The main limitations of this soil for most urban uses are shrinking and swelling with changes in moisture content, a clayey subsoil, low strength, and corrosivity to uncoated steel. These limitations, however, can be overcome by good design and careful installation. The clayey layer in the lower part of this soil, which restricts permeability, is a limitation for septic tank absorption fields. Recreational areas are limited by the very slow permeability and, in some places, by slope.

This soil is in capability subclass IIIe and in the Claypan Prairie range site.

6—Callahan loam, 2 to 5 percent slopes, eroded. These moderately deep, gently sloping, eroded soils are on uplands. Slopes are smooth and average about 3 percent. The surface layer has been thinned by erosion, and the subsoil is exposed in shallow, crossable gullies. The erosion has not been uniform, and in most areas the surface layer is 1 to 4 inches thick. In some places, however, the clayey subsoil has been mixed with the loamy surface layer by tillage and the texture is clay or clay loam. Soil areas are irregular in shape and range from 10 to several hundred acres.

Typically, the surface layer is brown, moderately alkaline loam about 3 inches thick. The subsoil is moderately alkaline clay that extends to a depth of 29 inches. It is reddish brown in the upper part and brown in the lower part. The underlying material to a depth of 40 inches is light yellowish brown, interbedded, shaly clay.

This soil is well drained. Runoff is medium. The permeability is very slow, and the available water capacity is low. Natural fertility and organic matter content are low.

Included with this soil in mapping are small areas of Bonti, Pedernales, Nukrum, Owens, Sagerton, and Throck soils. Also included are small areas of Callahan soils that are severely gullied, and some areas that are not eroded. The included soils make up less than 25 percent of a mapped area.

This Callahan soil can be cultivated, but it is used mainly for rangeland.

This soil is moderately suited to wheat and oats. Crop residue on the surface helps to prevent water erosion and conserve moisture. Contour farming and terracing are needed in most areas to prevent water erosion. Past erosion has reduced organic matter content and fertility and has caused lower crop yields.

This soil is moderately suited to pasture production. Improved grasses, such as kleingrass, King Ranch bluestem, and coastal bermudagrass, are suited.

This soil is favored for grazing because of the smooth topography and good forage production. The potential plant community is a mid and short grass prairie. The composition, by weight, is about 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

The predominant plants are sideoats grama, 15 percent; silver bluestem, 15 percent; Texas needlegrass, 15 percent; Arizona cottontop, 10 percent; white tridens, 10 percent; buffalograss, 10 percent; vine-mesquite, 10 percent; and other perennial grasses, 5 percent. Forbs, such as heath aster, bundleflower, and Engelmann-daisy, make up 5 percent; and woody plants, such as hackberry and lotebush, make up 5 percent.

Sideoats grama, Arizona cottontop, and vine-mesquite, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, mainly buffalograss, silver bluestem, Texas needlegrass, and lotebush. If heavy grazing continues, the less preferred plants also decline, and threeawn, Texas grama, red grama, other forbs, tasajillo, pricklypear, and mesquite invade. Mesquite continues to increase, along with lotebush, pricklypear, and tasajillo.

This soil provides fair nesting areas for doves, quail, and songbirds. An absence of woody plants for food and cover limits this soil as a habitat for wildlife.

The main limitations of this soil for most urban uses are shrinking and swelling with changes in moisture content, a clayey subsoil, low strength, and corrosivity to uncoated steel. These limitations can be overcome by proper design and careful installation. The clayey, very slowly permeable subsoil is a limitation for septic tank absorption fields. Special design is needed. In some places, the very slow permeability and slope are limitations for recreation uses.

This soil is in capability subclass IVe and in the Claypan Prairie range site.

7—Chaney loamy fine sand, 1 to 3 percent slopes. This deep, gently sloping soil is on broad uplands. Slopes are slightly convex to slightly concave and average less than 2 percent. Areas are small and irregularly shaped to broad and range from 10 to several hundred acres.

Typically, the surface layer is neutral loamy fine sand about 14 inches thick. It is brown in the upper part and pink in the lower part. The subsoil between a depth of 14 and 45 inches is neutral, light yellowish brown sandy clay that is mottled with red in the upper part and gray in the lower part. The underlying layer between a depth of 45 and 72 inches is moderately alkaline, light gray sandy clay loam.

This soil is moderately well drained. Runoff is slow. The permeability is slow, and the available water capacity is high. The hazard of soil blowing is severe.

Included with this soil in mapping are small areas of Pedernales, Cisco, and Demona soils. Also included are a few small gullied areas, some areas of Chaney fine sandy loam, and some areas of nearly level Chaney soils. The included soils make up as much as 15 percent of a mapped area.

This Chaney soil is used mainly for cropland and pastureland. Peanuts and grain sorghum are the main crops. A few areas are used for rangeland.

This soil is well suited to peanuts and moderately suited to grain sorghum. Peaches, apples, and melons are also well suited. Crop residue on the surface helps to conserve moisture and control soil blowing. Contour farming and terracing are needed in most areas to prevent water erosion.

This soil is well suited to pastureland. Improved grasses, such as coastal bermudagrass, weeping lovegrass (fig. 2), and kleingrass, are well suited to this soil.

The potential rangeland plant community is a mid and tall grass, post oak savannah. The composition, by weight, is about 80 percent grasses, 5 percent forbs, and 15 percent woody plants.

The predominant plants are little bluestem, 30 percent; indiangrass, 10 percent; sand lovegrass, 10 percent; and big bluestem, purpletop tridens, sideoats grama, silver bluestem, tall dropseed, and Canada wildrye, each 5 percent. Forbs, such as Maximilian sunflower, bundleflower, and Engelmann-daisy make up 5 percent. Woody plants, such as post oak and blackjack oak, make up 10 percent and 5 percent, respectively.

Little bluestem, indiangrass, and sand lovegrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as sideoats grama, silver bluestem, dropseed, hooded windmillgrass, skunkbush sumac, and post oak. If heavy grazing continues, the less preferred plants, with the exception of post oak and skunkbush sumac, also decline, and threeawn, low panicum, lovegrass, other forbs, prickly ash, and greenbrier invade. Post oak continues to increase, along with

Figure 2.—Weeping lovegrass on Chaney loamy fine sand, 1 to 3 percent slopes.

blackjack oak, shin oak, greenbrier, and skunkbush sumac.

This soil provides good habitat for deer and good nesting areas for doves, quail, turkeys, and songbirds. The woody cover attracts fur bearing animals.

Limitations of this soil for most urban and recreation uses are shrinking and swelling with changes in moisture content, low strength, slow permeability, and the sandy surface layer. These limitations need to be considered in the design of structures.

This soil is in capability subclass IIIe and in the Loamy Sand range site.

8—Chaney stony sandy loam, 1 to 8 percent slopes. This deep, gently sloping to sloping soil is on convex, stony knolls and ridges on uplands. Areas are irregular in shape and range from 10 to several hundred acres. Conglomerate sandstone boulders, stones, and cobbles cover from 2 to 20 percent of the surface. These fragments rest on the surface layer and are not imbedded in the soil. About 90 percent of this map unit is Chaney stony sandy loam and closely similar soils, and about 10 percent is contrasting soils. One of the similar soils is moderately deep over limestone or conglomerate bedrock, and the other is very gravelly throughout. The use and management of these soils is similar.

Typically, the surface layer of the Chaney soil is neutral, brownish stony sandy loam about 8 inches thick. The subsoil extends to a depth of 60 inches. It is slightly acid, red sandy clay between a depth of 8 and 17 inches; medium acid, reddish brown sandy clay between a depth of 17 and 26 inches; and firm, medium acid, brownish yellow sandy clay with light gray mottles between a depth of 26 and 41 inches. The lower part of the subsoil between a depth of 41 and 60 inches is medium acid, light gray clay with brownish mottles.

Chaney soil is moderately well drained. Runoff is medium. The permeability is slow, and the available water capacity is high.

Included with this soil in mapping are small areas of Callahan and Pedernales soils, areas of shallow loamy soils overlying conglomerate sandstone, and outcrops of rock. The included soils and rock outcrop make up as much as 10 percent of a mapped area.

This Chaney soil is best suited to rangeland. Most areas are too stony for use as cropland and pastureland. A few areas are arable, but they are so small and irregularly shaped that cultivation is impractical. A few small fields are planted to kleingrass or weeping lovegrass.

The potential rangeland plant community is a tall and mid grass, post oak savannah. The composition, by weight, is about 80 percent grasses, 10 percent forbs, and 10 percent woody plants.

The predominant plants are little bluestem, 30 percent; big bluestem, 10 percent; indiangrass, 10 percent; sideoats grama, 10 percent; and silver bluestem, Arizona cottontop, Texas needlegrass, and sand lovegrass, each 5 percent. Forbs, such as prairie-clover, Engelmann-daisy, and Maximilian sunflower, make up 10 percent; and woody plants, such as post oak, blackjack oak, and live oak, make up 10 percent.

Little bluestem, indiangrass, and big bluestem, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as Texas needlegrass, sideoats grama, silver bluestem, Arizona cottontop, dropseed, hooded windmillgrass, catclaw, and post oak. If heavy grazing continues, the less preferred plants, with the exception of post oak, catclaw, and skunkbush sumac, also decline, and threeawn, dropseed, lovegrass, other forbs, mesquite, tasajillo, and lotebush invade. Post oak continues to increase, along with catclaw, lotebush, greenbrier, and skunkbush sumac.

This soil provides good habitat for deer and good nesting areas for quail, doves, turkeys, and songbirds. The woody vegetation and rocks attract fur bearing animals.

This soil has severe limitations for most urban and recreation uses. Slope, shrinking and swelling with changes in moisture content, low strength, and the stony surface layer are the most limiting features.

This soil is in capability subclass VIs and in the Sandy Loam range site.

9—Chaney Variant loamy fine sand, 0 to 1 percent slopes. This deep, nearly level soil is on uplands in depressional areas that are ponded after heavy rainfall. The areas are circular to oblong and range from 2 to 10 acres. These areas are lower lying than the adjacent or surrounding Chaney soils. Ponding occurs about once in 3 years, and lasts from 1 to about 7 days.

Typically, the surface layer is loamy fine sand about 18 inches thick. It is grayish in the upper part and brownish in the lower part. The subsoil extends to a depth of 65 inches. It is grayish clay with reddish and brownish mottles to a depth of 50 inches and gray sandy clay with brownish mottles to a depth of 65 inches. Reaction is mildly alkaline in the upper part and moderately alkaline in the lower part.

This soil is somewhat poorly drained. The permeability is slow, and the available water capacity is high. Runoff is very slow or ponded. This soil receives additional water as runoff from soils in the higher lying areas. The hazard of soil blowing is severe.

Included with this soil in mapping are small areas of Demona soils. Also included are a few areas of soils that have a loam or fine sandy loam surface layer and a dark gray, clayey subsoil. These soils are in the lowest parts of the depressional areas and are often ponded from 1 to 3 weeks after a heavy rainfall. The included soils make up less than 20 percent of any mapped area.

This Chaney Variant soil is used mainly for pastureland or rangeland. It is well suited to pastureland. Improved grasses, such as coastal bermudagrass, grow well on this soil.

This soil is well suited to peanuts and moderately suited to grain sorghum and small grain. Crop residue left on the surface helps to conserve moisture and control wind blowing. Water standing in the fields after heavy rainfall makes cultivation and harvesting of crops difficult in some years.

The potential rangeland plant community is a mid and tall grass, post oak savannah. The composition, by weight, is about 80 percent grasses, 5 percent forbs, and 15 percent woody plants.

The predominant plants are little bluestem, 30 percent; indiangrass, 10 percent; sand lovegrass, 10 percent; and big bluestem, purpletop tridens, sideoats grama, silver bluestem, tall dropseed, and Canada wildrye, each 5 percent. Forbs, such as Maximilian sunflower, bundleflower, and Engelmann-daisy, make up 5 percent. Woody plants, such as post oak and blackjack oak, make up 10 percent and 5 percent, respectively.

Little bluestem, indiangrass, and sand lovegrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as sideoats grama, silver bluestem, dropseed, hooded windmillgrass, skunkbush sumac, and post oak. If heavy grazing continues, the less preferred plants, with the exception of post oak and skunkbush sumac, also decline, and threeawn, low panicum, lovegrass, other forbs, prickly ash, and greenbrier invade. Post oak continues to increase, along with blackjack oak, shin oak, greenbrier, and skunkbush sumac.

This soil provides good habitat for deer and good nesting areas for doves, quail, turkeys, and songbirds. Waterfowl and shorebirds use these areas when they are ponded. The woody cover attracts fur bearing animals. The soil has good value for wildlife habitat and livestock production.

The main limitations of this soil for most urban or recreation uses are the hazard of flooding, shrinking and swelling with changes in moisture content, low strength, and slow permeability.

This soil is in capability subclass IIIw and in the Loamy Sand range site.

10—Cho gravelly loam, 1 to 5 percent slopes. This very shallow to shallow, gently sloping soil is on uplands. Slopes are convex and average about 2 percent. Areas are irregular in shape and range about 10 to slightly over 100 acres.

Typically, the surface layer is moderately alkaline, brown gravelly loam about 10 inches thick. Caliche fragments are common. The underlying material is pinkish white, strongly cemented caliche to a depth of 15 inches and friable, pink gravelly loam that has many caliche limestone, chert, and siliceous pebbles between a depth of 15 and 50 inches.

This soil is well drained. Runoff is medium. The permeability is moderate, and the available water capacity is very low. The root zone is very shallow to shallow.

Included with this soil in mapping are small areas of Mereta and Nuvalde soils and areas of Cho clay loam. Also included, on the lower slopes, are areas of Cho loam and a soil similar to Cho loam that overlies friable marl. The included soils make up as much as 20 percent of a mapped area.

This Cho soil is poorly suited to cropland or pastureland. A few areas are used for cultivated crops, but most areas are used for rangeland.

The potential rangeland plant community is a mid and short grass prairie with scattered live oak. The composition, by weight, is 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

The predominant plants are sideoats grama, 30 percent; slim and rough tridens, 15 percent; buffalograss and curly mesquite, 15 percent; hairy dropseed, 10 percent; Texas needlegrass, 10 percent; and silver bluestem and little bluestem, each 5 percent. Forbs, such as prairie-clover, dotted gayfeather, and Engelmann-daisy, make up 5 percent, and woody plants such as live oak make up 5 percent.

Little bluestem, sideoats grama, and slim tridens, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as Texas needlegrass, silver bluestem, buffalograss, curly mesquite, and dropseed. If heavy grazing continues, the less preferred plants also decline, and threeawn, hairy tridens, fall witchgrass, red grama, and pricklypear invade.

This soil provides fair nesting areas for quail and songbirds. Fur bearing animals inhabit some areas.

This soil is limited for urban uses because of shallow depth to a cemented pan. It is restricted for recreation uses such as playgrounds because of small stones and slope.

This soil is in capability subclass IVs and in the Very Shallow range site.

11—Cisco loamy fine sand, 1 to 3 percent slopes. This deep, gently sloping soil is on uplands. Slopes are smooth and average about 2 percent. Areas are broad to irregular in shape and range from 10 to several hundred acres.

Typically, this soil has a surface layer of brownish loamy fine sand about 10 inches thick. The subsoil extends to a depth of 51 inches. It is sandy clay loam that is reddish in the upper part and yellowish in the lower part. The underlying material is light gray sandy clay loam. Reaction is typically neutral in the upper part and moderately alkaline in the lower part.

This soil is well drained. Runoff is very slow. The permeability is moderate, and the available water capacity is high. The root zone is deep and easily penetrated by roots. The hazard of soil blowing is severe.

Included with this soil in mapping are small areas of Pedernales and Chaney soils and a few areas of nearly level Cisco soils. Also included, on convex slopes, are a few eroded spots of Cisco soils that have a surface layer mostly of sandy loam because of the mixing of the surface layer and subsoil by tillage. The included soils make up less than 15 percent of a mapped area.

This Cisco soil is mostly used for cropland, but some areas are used for pastureland and rangeland. Peanuts is the main crop.

This soil is well suited to peanuts and moderately suited to grain sorghum. Peaches, apples, and melons are also well suited. Good management includes leaving crop residue on the surface, timely and limited tillage, and the use of cover crops. These practices help to control soil blowing and water erosion. Contour farming and terracing are also needed in most areas to help control water erosion.

This soil is well suited to pastureland. Improved grasses, such as coastal bermudagrass, weeping lovegrass, and kleingrass, grow well on this soil.

The potential rangeland plant community is a mid and tall grass, post oak savannah. The composition, by weight, is about 80 percent grasses, 5 percent forbs, and 15 percent woody plants.

The predominant plants are little bluestem, 30 percent; indiangrass, 10 percent; sand lovegrass, 10 percent; and big bluestem, purpletop tridens, sideoats grama, silver bluestem, tall dropseed, and Canada wildrye, each 5 percent. Forbs, such as Maximilian sunflower, bundleflower, and Engelmann-daisy, make up 5 percent. Woody plants, such as post oak and blackjack oak, make up 10 percent and 5 percent, respectively.

Little bluestem, indiangrass, and sand lovegrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as sideoats grama, silver bluestem, dropseed, hooded windmillgrass, skunkbush sumac, and

post oak. If heavy grazing continues, the less preferred plants, with the exception of post oak and skunkbush sumac, also decline, and threeawn, low panicum, lovegrass, other forbs, prickly ash, and greenbrier invade. Post oak continues to increase, along with blackjack oak, shin oak, greenbrier, and skunkbush sumac.

This soil provides good habitat for deer and good nesting areas for doves, quail, turkeys, and songbirds. The woody cover attracts fur bearing animals.

The main limitations of this soil for most urban and recreation uses are low strength, moderate shrinking and swelling with changes in moisture content, and the sandy surface layer. However, these limitations can easily be overcome by proper installation of structures.

This soil is in capability subclass IIIe and in the Loamy Sand range site.

12—Cisco fine sandy loam, 1 to 3 percent slopes. This deep, gently sloping soil is on uplands. Slopes are smooth and average about 2 percent. Areas are broad to irregular in shape and range from 10 to more than 200 acres.

Typically, the surface layer is slightly acid, reddish brown fine sandy loam about 9 inches thick. The subsoil extends to a depth of 49 inches. It is slightly acid, yellowish red sandy clay loam to a depth of 42 inches and moderately alkaline, yellowish red sandy clay loam to a depth of 49 inches. The underlying material to a depth of 65 inches is calcareous, pink sandy clay loam (fig. 3).

This soil is well drained. Runoff is slow. The permeability is moderate, and the available water capacity is high. Tilth is good, and the soil can be worked throughout a wide range of moisture content. The root zone is deep and easily penetrated by roots.

Included with this soil in mapping are small areas of Pedernales and Hext soils, mostly on low knolls. Also included are a few areas of soils that are similar to this Cisco soil, except that the sandy clay loam subsoil extends to a depth of more than 60 inches. The included soils make up as much as 20 percent of a mapped area.

This Cisco soil is mainly used for cropland. Oats and peanuts are the main cultivated crops. A few areas are used for rangeland.

This soil is well suited to peanuts and moderately suited to grain sorghum and small grain. Peaches, apples, and melons are also well suited. Crop residue left on the surface helps to conserve moisture, control soil blowing, and maintain tilth. Terracing and contour farming help to control water erosion.

This soil is well suited to pastureland. Improved grasses, such as coastal bermudagrass, kleingrass, and weeping lovegrass, are commonly grown.

The potential rangeland plant community is a tall and mid grass, post oak savannah. The composition, by weight, is about 80 percent grasses, 10 percent forbs, and 10 percent woody plants.

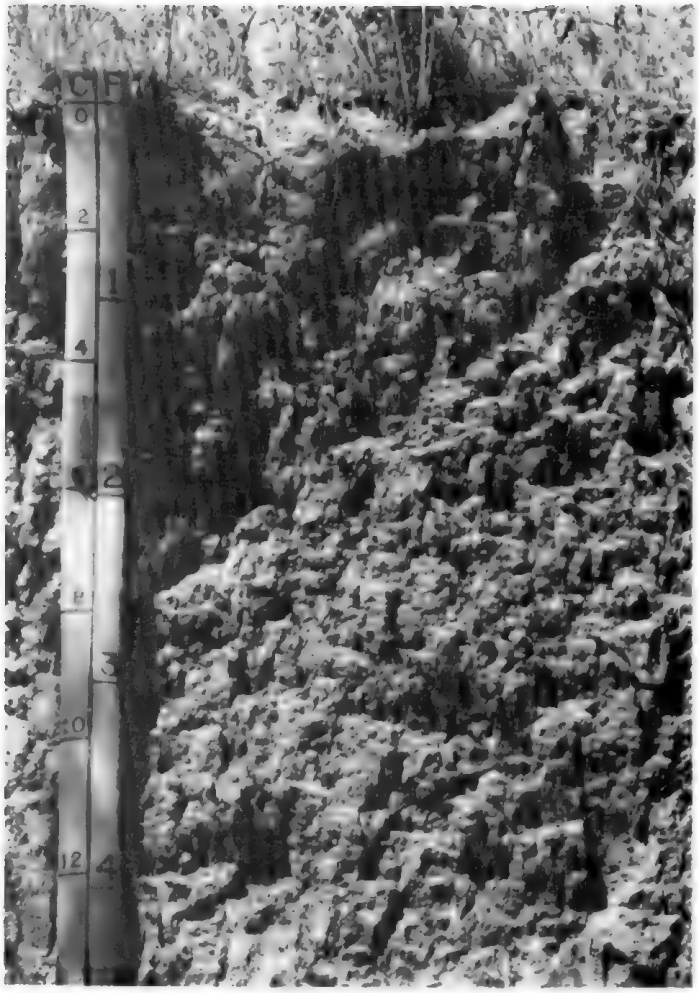


Figure 3.—Profile of Cisco fine sandy loam, 1 to 3 percent slopes. The subsoil has subangular blocky structure and is moderately permeable. The soil is calcareous at a depth of about 50 inches. Depths are shown in centimeters (c) and feet (f). Multiply the figure on the left by 10 to determine the depth in centimeters.

The predominant plants are little bluestem, 30 percent; big bluestem, 10 percent; indiangrass, 10 percent; sideoats grama, 10 percent; and silver bluestem, Arizona cottontop, Texas needlegrass, and sand lovegrass, each 5 percent. Forbs, such as prairie-clover, Engelmann-daisy, and Maximilian sunflower, make up 10 percent; and woody plants, such as post oak, blackjack oak, and live oak, make up 10 percent.

Little bluestem, indiangrass, and big bluestem, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as Texas needlegrass, sideoats grama, silver bluestem, Arizona cottontop, dropseed, hooded windmillgrass, catclaw, and post oak. If heavy grazing continues, the less preferred plants, with the exception of post oak, catclaw, and skunkbush sumac, also

decline, and threeawn, dropseed, lovegrass, other forbs, mesquite, tasajillo, and lotebush invade. Post oak continues to increase, along with catclaw, lotebush, greenbrier, and skunkbush sumac.

This soil provides good habitat for deer and good nesting areas for quail, doves, turkeys, and songbirds. The woody vegetation attracts fur bearing animals.

The main limitations of this soil for most urban uses are low strength and moderate shrinking and swelling with changes in moisture content. These limitations, however, can be overcome by good design and careful installation. There are no major limitations for recreation uses.

This soil is in capability subclass IIe and in the Sandy Loam range site.

13—Cisco fine sandy loam, 1 to 5 percent slopes, eroded. This deep, gently sloping soil is on uplands. Slopes are smooth and average about 3 percent. Shallow gullies and rills are common. Areas that have had 50 to 75 percent of the surface layer removed by erosion are at intervals of 100 to 300 feet. In most cultivated fields, the surface layer is of redder hue than is typical because some of the redder subsoil material has been mixed into it by tillage. Areas are irregular in shape and range from 10 to 200 acres.

Typically, the surface layer is mildly alkaline, yellowish red fine sandy loam about 5 inches thick. The subsoil extends to a depth of 42 inches. It is neutral, reddish brown and yellowish red sandy clay loam between a depth of 5 and 31 inches, and mildly alkaline, yellowish red sandy clay loam between a depth of 31 and 42 inches. The underlying material is massive, pink, calcareous sandy clay loam.

This soil is well drained. Runoff is medium. The permeability is moderate, and the available water capacity is high. The hazards of water erosion and soil blowing are moderate.

Included with some areas of this soil in mapping are small areas of Pedernales and Hext soils. Also included are uneroded areas of Cisco fine sandy loam and areas of Cisco loamy fine sand. The included soils make up less than 20 percent of a mapped area.

This Cisco soil is suitable for cultivated crops but is used mainly for pastureland and rangeland.

This soil is moderately suited to pastureland. Improved grasses, such as coastal bermudagrass, kleingrass, and weeping lovegrass, are well suited.

This soil is moderately suited to peanuts, grain sorghum, and small grain. Crop residue left on the surface helps to conserve moisture, control erosion, and maintain tilth. Terracing and contour farming help to control water erosion. Past erosion has reduced organic matter content and fertility and has caused lower crop yields.

The potential rangeland plant community is a tall and mid grass, post oak savannah. The composition, by weight, is about 80 percent grasses, 10 percent forbs, and 10 percent woody plants.

The predominant plants are little bluestem, 30 percent; big bluestem, 10 percent; indiangrass, 10 percent; sideoats grama, 10 percent; and silver bluestem, Arizona cottontop, Texas needlegrass, and sand lovegrass, each 5 percent. Forbs, such as prairie-clover, Engelmann-daisy, and Maximilian sunflower, make up 10 percent; and woody plants, such as post oak, blackjack oak, and live oak, make up 10 percent.

Little bluestem, indiangrass, and big bluestem, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as Texas needlegrass, sideoats grama, silver bluestem, Arizona cottontop, dropseed, hooded windmillgrass, catclaw, and post oak. If heavy grazing continues, the less preferred plants, with the exception of post oak, catclaw, and skunkbush sumac, also decline, and threeawn, dropseed, lovegrass, other forbs, mesquite, tasajillo, and lotebush invade. Post oak continues to increase, along with catclaw, lotebush, greenbrier, and skunkbush sumac.

This soil provides good habitat for deer and good nesting areas for quail, doves, turkeys, and songbirds. The woody vegetation attracts fur bearing animals.

The main limitations of this soil for most urban uses are low strength and shrinking and swelling with changes in moisture content. However, these limitations can be overcome by good design and careful installation. There are no major limitations for most recreation uses. Slope, however, restricts some playground uses.

This soil is in capability subclass IIIe and in the Sandy Loam range site.

14—Cisco-Hext-Pedernales complex, 1 to 5 percent slopes. These gently sloping soils are on uplands. Slopes average about 3 percent. Areas are irregular in shape and range from 10 to several hundred acres.

The Cisco soil and similar soils make up about 40 percent of the complex; Hext soil, about 30 percent; Pedernales soil, about 15 percent; and other soils, about 15 percent. The Cisco soil is on the lower and middle parts of the slopes, the Hext soil is on ridgetops and slight knolls, and the Pedernales soil is on the upper parts of the slopes. These soils are so intricately mixed that separation is not practical at the scale used for mapping.

Typically, the Cisco soil has a surface layer of neutral, brown fine sandy loam about 6 inches thick. The subsoil extends to a depth of 43 inches. The upper part between a depth of 6 and 29 inches is neutral, yellowish red sandy clay loam, and the lower part between 29 and 43 inches is mildly alkaline, reddish yellow sandy clay loam. The underlying material between a depth of 43 and 50 inches is very pale brown fine sandy loam that has accumulations of calcium carbonate. Two soils similar to this Cisco soil were included with this complex in mapping. One has mixed mineralogy and accumulations

of carbonates at depths above 30 inches, and the other has a thicker subsoil and no free carbonates.

This Cisco soil is well drained. Runoff is medium. The permeability is moderate, and the available water capacity is high.

Typically, the Hext soil has a surface layer of moderately alkaline, brown loam about 6 inches thick. The subsoil between a depth of 6 and 22 inches is moderately alkaline loam. It is light brown in the upper part and pink in the lower part. The underlying material between a depth of 22 and 28 inches is pinkish gray loam that contains accumulations of calcium carbonate. It is underlain by pinkish white, weakly consolidated sandstone.

This Hext soil is well drained. Runoff is slow to medium. The permeability is moderate, and the available water capacity is low. The hazard of water erosion is moderate.

Typically, the Pedernales soil has a surface layer of mildly alkaline, brown fine sandy loam about 7 inches thick. The subsoil extends to a depth of 38 inches. Between 7 and 31 inches, it is mildly alkaline, yellowish red sandy clay, and between 31 and 38 inches, it is moderately alkaline, reddish yellow sandy clay loam that contains concretions of calcium carbonate. The underlying layer between a depth of 38 and 45 inches is moderately alkaline, pink sandy clay loam that contains concretions and masses of calcium carbonate.

This Pedernales soil is well drained. Runoff is medium. The permeability is moderately slow, and the available water capacity is high.

Included with this complex in mapping are small areas of Abilene, Nuvalde, and Sagerton soils. Also included are shallow gullied areas and eroded areas where most of the surface layer has been removed.

The soils in this Cisco-Hext-Pedernales complex can be cultivated, but they are used mainly for rangeland or improved pastureland.

These soils are moderately suited to oats and grain sorghum. Crop residue left on the surface helps to conserve moisture and maintain tilth and productivity. Contour farming and terracing are needed in most areas to prevent water erosion.

These soils are moderately suited to pastureland. Introduced grasses, such as kleingrass, coastal bermudagrass, and weeping lovegrass, are suited.

The potential rangeland plant community on the Cisco and Hext soils is a tall and mid grass, post oak savannah. The composition, by weight, is about 80 percent grasses, 10 percent forbs, and 10 percent woody plants.

The predominant plants are little bluestem, 30 percent; big bluestem, 10 percent; indiangrass, 10 percent; sideoats grama, 10 percent; and silver bluestem, Arizona cottontop, Texas needlegrass, and sand lovegrass, each 5 percent. Forbs, such as prairie-clover, Engelmann-daisy, and Maximilian sunflower, make up 10 percent; and woody plants, such as post oak, blackjack oak, and live oak, make up 10 percent.

Little bluestem, indiangrass, and big bluestem, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as Texas needlegrass, sideoats grama, silver bluestem, Arizona cottontop, dropseed, hooded windmillgrass, catclaw, and post oak. If heavy grazing continues, the less preferred plants, with the exception of post oak, catclaw, and skunkbush sumac, also decline, and threeawn, dropseed, lovegrass, other forbs, mesquite, tasajillo, and lotebush invade. Post oak continues to increase, along with catclaw, lotebush, greenbrier, and skunkbush sumac.

Cattle graze this soil often because of the variety and palatability of forage species. The potential rangeland plant community on the Pedernales soil is a mid grass, post oak savannah. The composition, by weight, is about 75 percent grasses, 10 percent forbs, and 15 percent woody plants.

Predominant plants are sideoats grama, 15 percent; little bluestem, 10 percent; vine-mesquite, 10 percent; Texas needlegrass, 10 percent; and Arizona cottontop, hooded windmillgrass, silver bluestem, Canada wildrye, buffalograss, and sand dropseed, each 5 percent. Forbs, such as prairie-clover, Engelmann-daisy, and heath aster, make up 10 percent. Woody plants such as post oak make up 10 percent, and skunkbush sumac makes up 5 percent.

Little bluestem, indiangrass, and Canada wildrye, which are preferred plants, are grazed out first by heavy grazing. They are replaced by less preferred plants, such as sideoats grama, silver bluestem, Arizona cottontop, Texas needlegrass, hooded windmillgrass, skunkbush sumac, and post oak. If heavy grazing continues, these plants, with the exception of post oak and skunkbush sumac, also decline, and threeawn, low panicums, tumble lovegrass, other forbs, and mesquite invade. Post oak continues to increase along with greenbrier, elm, mesquite, and skunkbush sumac.

The complex provides good habitat for deer and good nesting areas for doves, quail, turkeys, and songbirds. The hollow trees attract fur bearing animals.

These soils are limited for most urban and recreation uses because of slope and low strength.

The soils in this complex are in capability subclass IVe. The Cisco soil and the Hext soil are in the Sandy Loam range site, and the Pedernales soil is in the Tight Sandy Loam range site.

15—Cisco-Hext-Pedernales association, undulating. This association is on undulating uplands (fig. 4). Slopes range from 2 to 8 percent but average about 6 percent. Areas are irregular in shape and range from 10 to several hundred acres. Some areas have a few scattered rocks on the surface.

The Cisco soil and similar soils make up about 40 percent of the association; Hext soil, about 25 percent; Pedernales soil, about 15 percent; and other soils, about 20 percent. The Cisco soil is on the middle and lower parts of the slopes, and the Hext soil is on the tops of

Figure 4.—Typical area of reseeded rangeland in Cisco-Hext-Pedernales association, undulating. The scattered trees are oak and juniper.

knolls and ridges. The Pedernales soil is on the upper part of the slopes. Areas of this map unit are mostly large, and the composition is variable. However, the detail is adequate for the foreseeable uses of these soils.

Typically, the Cisco soil has a surface layer of neutral, brown fine sandy loam about 8 inches thick. The subsoil between a depth of 8 and 43 inches is neutral, reddish sandy clay loam. The underlying material between a depth of 43 and 60 inches is reddish yellow fine sandy loam that has accumulations of calcium carbonate. Two soils in this association are closely similar. One has mixed mineralogy and carbonates at depths above 30 inches, and the other has a thicker subsoil and no free carbonates.

Cisco soil is well drained. Runoff is medium. The permeability is moderate, and the available water capacity is high.

Typically, the Hext soil has a surface layer of moderately alkaline, pale brown loam about 5 inches thick. The subsoil between a depth of 5 and 20 inches is moderately alkaline, light gray loam that contains accumulations of calcium carbonate. The underlying material between a depth of 20 and 30 inches is weakly consolidated sandstone.

Hext soil is well drained. Runoff is medium. The permeability is moderate, and the available water capacity is low. The hazard of water erosion is moderate.

Typically, the Pedernales soil has a surface layer of brownish fine sandy loam about 11 inches thick. The subsoil between a depth of 11 and 46 inches is sandy clay that is red in the upper part and mottled with red,

brown, and yellow in the lower part. The underlying material between a depth of 46 and 60 inches is pinkish white packsand that is friable when wet. Reaction is neutral in the upper part and moderately alkaline in the lower part.

Pedernales soil is well drained. Runoff is medium. The permeability is moderately slow, and the available water capacity is high.

Included with this association in mapping are small areas of Nuvalde and Brackett soils and areas of loamy soils on bottom lands. Also included are areas of eroded soils where most of the surface layer has been removed.

These Cisco-Hext-Pedernales soils are used mostly for rangeland and wildlife habitat. A few areas are used for pastureland.

Because of gravel and slope, these soils are not suited to cultivated crops. The Cisco and Pedernales soils are moderately suited to pastureland (fig. 5), but most areas of the Hext soil are too gravelly or stony for this use.

The potential rangeland plant community on the Cisco and Hext soils is a tall and mid grass, post oak savannah. The composition, by weight, is about 80 percent grasses, 10 percent forbs, and 10 percent woody plants.

The predominant plants are little bluestem, 30 percent; big bluestem, 10 percent; indiangrass, 10 percent; sideoats grama, 10 percent; and silver bluestem, Arizona cottontop, Texas needlegrass, and sand lovegrass, each

Figure 5.—Coastal bermudagrass on Cisco fine sandy loam in an area of Cisco-Hext-Pedernales association, undulating.

5 percent. Forbs, such as prairie-clover, Engelmann-daisy, and Maximilian sunflower, make up 10 percent; and woody plants, such as post oak, blackjack oak, and live oak, make up 10 percent.

Little bluestem, indiangrass, and big bluestem, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as Texas needlegrass, sideoats grama, silver bluestem, Arizona cottontop, dropseed, hooded windmillgrass, catclaw, and post oak. If heavy grazing continues, the less preferred plants, with the exception of post oak, catclaw, and skunkbush sumac, also decline, and threeawn, dropseed, lovegrass, other forbs, mesquite, tasajillo, and lotebush invade. Post oak continues to increase, along with catclaw, lotebush, greenbrier, and skunkbush sumac.

The potential rangeland plant community on the Pedernales soil is a mid grass, post oak savannah. The composition, by weight, is about 75 percent grasses, 10 percent forbs, and 15 percent woody plants. Cattle graze this soil often because of the variety and palatability of the forage species.

The predominant plants are sideoats grama, 15 percent; little bluestem, 10 percent; vine-mesquite, 10 percent; Texas needlegrass, 10 percent; and Arizona cottontop, hooded windmillgrass, silver bluestem, Canada wildrye, buffalograss, and sand dropseed, each 5 percent. Forbs, such as prairie-clover, Engelmann-daisy, and heath aster, make up 10 percent. Woody plants, such as post oak and skunkbush sumac, make up 10 percent and 5 percent, respectively.

Little bluestem, indiangrass, and Canada wildrye, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as sideoats grama, silver bluestem, Arizona cottontop, Texas needlegrass, hooded windmillgrass, skunkbush sumac, and post oak. If heavy grazing continues, the less preferred plants, with the exception of post oak and skunkbush sumac, also decline, and threeawn, low panicum, tumble lovegrass, other forbs, and mesquite invade. Post oak continues to increase, along with greenbrier, elm, mesquite, and skunkbush sumac.

These soils provide good habitat for deer and good nesting areas for doves, quail, turkeys, and songbirds. The hollow trees attract fur bearing animals.

The main limitations of these soils for most urban and recreation uses are slope, depth to rock, and low strength.

The soils in this association are in capability subclass VIe. The Cisco soil and the Hext soil are in the Sandy Loam range site, and the Pedernales soil is in the Tight Sandy Loam range site.

16—Demona-Patilo complex, 1 to 5 percent slopes. This complex of gently sloping soils is on uplands. Slopes are convex to concave and average about 2.5 percent. Areas are broad to irregular in shape and range from 10 to about 2,000 acres.

The Demona soil and closely similar soils make up about 50 percent of the complex; Patilo soil, about 30 percent; and other soils, about 20 percent. These soils are so intricately mixed that separate mapping was not practical at the scale used.

The Demona soil is in slightly concave areas and on foot slopes. Typically, the surface layer is brownish fine sand about 17 inches thick. The subsoil to a depth of 61 inches is sandy clay mottled in shades of brown, red, yellow, and gray. The underlying material between a depth of 61 and 70 inches is mottled sandy clay loam. Reaction is typically slightly acid in the upper part and moderately alkaline in the lower part. In some areas in this complex, there is a soil that is closely similar to Demona soil that has siliceous mineralogy and a subsoil of sandy clay loam.

Demona soil is moderately well drained. Runoff is slow. The permeability is moderately slow, and the available water capacity is medium. The hazard of soil blowing is severe.

The Patilo soil is on ridgetops or in dune-shaped areas. Typically, the surface layer is neutral, brownish fine sand to a depth of about 58 inches. The subsoil extends to a depth of 80 inches. The upper part to a depth of 66 inches is slightly acid, light gray sandy clay loam that has many yellowish red mottles. The lower part to a depth of 80 inches is medium acid, light gray and red sandy clay loam.

Patilo soil is moderately well drained. Runoff is slow. The permeability is moderately slow, and the available water capacity is low. The hazard of soil blowing is severe.

Included with this complex in mapping are small areas of Chaney and Cisco soils on the lower part of the foot slopes. In addition, most cultivated fields have wind deposits of sand several feet thick along the fence rows. The included soils and the sand accumulations make up about 20 percent of the complex.

These Demona-Patilo soils can be cultivated, but they are used mainly as rangeland or pastureland.

These soils are moderately suited to pastureland. Improved grasses, such as coastal bermudagrass and weeping lovegrass, are suited to the soils in this complex.

These soils are moderately suited to cultivated crops. Crop residue left on the surface helps to conserve moisture, control soil blowing, and maintain tilth. Cover crops and stripcropping help to prevent soil blowing. Response to applications of commercial fertilizer is good in most years.

The potential rangeland plant community on the Demona soil is a mid and tall grass, post oak and blackjack oak savannah. The composition, by weight, is about 80 percent grasses, 5 percent forbs, and 15 percent woody plants.

The predominant plants are little bluestem, 25 percent; big bluestem, 10 percent; indiangrass, 10 percent; purple

tridens, 10 percent; and sand lovegrass, tall dropseed, silver bluestem, plains lovegrass, and Scribner panicum, each 5 percent. Forbs, such as trailing wildbean, evening primrose, catclaw sensitivebrier, and dotted gayfeather, make up 5 percent; and woody plants, such as post oak and blackjack oak, make up 10 percent and 5 percent, respectively.

Little bluestem, indiangrass, and big bluestem, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as silver bluestem, dropseed, hooded windmillgrass, skunkbush sumac, and post oak. If heavy grazing continues, the less preferred plants, with the exception of post oak and skunkbush sumac, also decline, and threeawn, low panicums, tumble lovegrass, other forbs, and catclaw invade. Post oak continues to increase, along with prickly ash, blackjack oak, greenbrier, and skunkbush sumac.

The potential rangeland plant community on the Patilo soil is a mid grass, post oak and blackjack oak savannah. A few tall grasses grow in the scattered open areas. The composition, by weight, is about 45 percent grasses, 5 percent forbs, and 50 percent woody plants. Cattle graze this soil very little because of the woody plants and low forage production.

The predominant grasses are sand lovegrass, 25 percent; indiangrass, 5 percent; switchgrass, 5 percent; purpletop tridens, 5 percent; and red lovegrass, 5 percent. Forbs, such as trailing wildbean and lespedeza, make up 5 percent. Woody plants, such as post oak and blackjack oak, make up 40 percent of the composition, and greenbrier and skunkbush sumac make up 10 percent.

Sand lovegrass, indiangrass, and switchgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as red lovegrass, Scribner panicum, dropseed, greenbrier, and post oak. If heavy grazing continues, the less preferred plants, with the exception of post oak, greenbrier, and skunkbush sumac, also decline, and threeawn, low panicum, other forbs, and prickly ash invade. Post oak continues to increase, along with blackjack oak, bumelia, shinnery oak, and greenbrier.

These soils provide good habitat for deer and good nesting areas for doves, quail, turkeys, and songbirds. The woody plant cover attracts fur bearing animals. These soils probably have greater value as wildlife habitat than for cattle production.

The main limitations of these soils for most urban uses are slope, wetness, and the loose, sandy surface layer. These limitations can be overcome by good design and careful installation. The sandy surface layer is a limitation for most recreation uses.

The soils in this complex are in capability subclass IIIe. The Demona soil is in the Sandy range site, and the Patilo soil is in the Deep Sand range site.

17—Frio clay loam, occasionally flooded. This deep, nearly level, calcareous soil is on flood plains along major streams. Slopes are smooth and range from 0 to 1 percent. Areas are mostly long and narrow and range from 10 to several hundred acres. Most areas of this soil are subject to flooding about once in every 3 to 10 years. In some places, however, the soils are rarely flooded because they are protected by flood prevention structures.

Typically, the surface layer is about 27 inches thick. The upper part is dark grayish brown clay loam, and the lower part is dark brown silty clay. The subsoil extends to a depth of 70 inches. It is yellowish brown silty clay loam between a depth of 27 and 61 inches and brown silty clay loam between a depth of 61 and 70 inches. Reaction is moderately alkaline throughout.

This soil is well drained. Runoff is slow. The permeability is moderately slow, and the available water capacity is high. Natural fertility and organic matter content are high. The rooting zone is deep.

Included with this soil in mapping are small areas of Gageby soils and areas of soils in stream channels. Also included, in some places, are small areas of Nukrum and Nuvalde soils at a slightly higher elevation. The included soils make up less than 20 percent of a mapped area.

This Frio soil is used for cropland, pastureland, orchards, and rangeland. Small grain and grain sorghum are the main cultivated crops. Pecans are the main orchard crop.

This soil is well suited to wheat, oats, forage sorghum, cotton, and grain sorghum. Crop residue left on the surface helps to conserve moisture and maintain tilth and productivity. Pecans are also well suited.

This soil is well suited to pastureland. Pasture grasses, such as coastal bermudagrass, kleingrass, and johnsongrass, are commonly grown.

The potential rangeland plant community is a mid and tall grass flood plain with scattered trees. The composition, by weight, is about 70 percent grasses, 10 percent forbs, and 20 percent woody plants.

The predominant plants are vine-mesquite, 15 percent; sideoats grama, 10 percent; switchgrass, 10 percent; little bluestem, 10 percent; and big bluestem, indiangrass, Texas needlegrass, Canada wildrye, and meadow dropseed, each 5 percent. Forbs, such as bundleflower, Maximilian sunflower, and Engelmann-daisy, make up 10 percent; and woody plants, such as hackberry, elm, live oak, and pecan, make up 20 percent.

Big bluestem, indiangrass, and switchgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as sideoats grama, Texas needlegrass, vine-mesquite, dropseed, silver bluestem, live oak, bumelia, and pecan. If heavy grazing continues, the less preferred plants, with the exception of live oak, bumelia, and pecan, also decline, and threeawn, buffalograss, red grama, annual grasses, other forbs, and mesquite invade. Mesquite

continues to increase, along with western soapberry, black willow, and bumelia.

This soil provides excellent habitat for squirrels and deer and good nesting areas for doves, quail, turkeys, and songbirds. The trees, shrubs, and water attract fur bearing animals. This soil has excellent value, both as wildlife habitat and for cattle production. Wildlife are attracted to this soil because of the mast, seed producing forbs, winter annuals, and cover.

This soil has severe limitations for most urban uses because it is subject to flooding. Flooding also is a hazard for most recreation uses, such as campsites and playgrounds.

This soil is in capability subclass IIw and in the Loamy Bottomland range site.

18—Frio-Gageby association, frequently flooded. This association of deep, nearly level soils is on flood plains. The soils are mainly along small streams where the channels have become filled with sediment and debris. Slopes range from 0 to 1 percent. Areas are long and narrow and range from 15 to several hundred acres. Most areas are subject to flooding once or twice a year.

The Frio soil makes up about 50 percent of the association; Gageby soil, about 35 percent; and other soils, about 15 percent. The composition of this association is more variable than that of other map units in the survey area. However, the detail of mapping is adequate for the foreseeable uses of these soils.

The Frio soil occurs at any elevation within the association, but it is generally away from the stream channel, and the surface is plane or slightly concave. Typically it has a surface layer of brown clay loam about 8 inches thick. The next layer is grayish brown silty clay loam to a depth of 24 inches. The subsoil to a depth of 43 inches is brown silty clay loam. The underlying material is brown gravelly clay loam to a depth of 50 inches or more. Reaction is typically moderately alkaline throughout.

The Gageby soil occurs at any elevation in this map unit but is mainly next to the stream channels. Typically, the surface layer is dark grayish brown loam about 11 inches thick. The next layer is brown sandy clay loam to a depth of 17 inches and dark grayish brown loam to a depth of 32 inches. The subsoil between a depth of 32 and 60 inches is dark grayish brown sandy clay loam. Reaction is moderately alkaline throughout.

These soils are well drained. Runoff is slow, and the available water capacity is high. The permeability is moderately slow in the Frio soil and moderate in the Gageby soil. Natural fertility and organic matter content are high.

Included with this association in mapping are small areas of more clayey soils in old sloughs or low areas where water stands for longer periods. Also included are a few small areas of soils that are gravelly throughout, and a few small sandy areas next to the stream channels. Some areas are dissected by shallow to moderately deep channels that meander back and forth within the flood plains. The included soils make up as much as 15 percent of a mapped area.

These Frio-Gageby soils generally are not suitable for cultivated crops because of the hazard of flooding. They are subject to washing or scouring and to deposition of fresh alluvial sediment. These soils are used mainly for rangeland. A few areas, however, have been planted to improved pasture grasses.

These soils are well suited to pasture production. Pasture grasses, such as johnsongrass, coastal bermudagrass, and kleingrass, are commonly grown.

The potential rangeland plant community is a mid and tall grass flood plain with scattered trees. The composition, by weight, is about 70 percent grasses, 10 percent forbs, and 20 percent woody plants.

The predominant plants are vine-mesquite, 15 percent; sideoats grama, 10 percent; switchgrass, 10 percent; little bluestem, 10 percent; and big bluestem, indiangrass, Texas needlegrass, Canada wildrye, and meadow dropseed, each 5 percent. Forbs, such as bundleflower, Maximilian sunflower, and Engelmann-daisy, make up 10 percent; and woody plants, such as hackberry, elm, live oak, and pecan, make up 20 percent.

Big bluestem, indiangrass, and switchgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as sideoats grama, Texas needlegrass, vine-mesquite, dropseed, silver bluestem, live oak, bumelia, and pecan. If heavy grazing continues, the less preferred plants, with the exception of live oak, bumelia, and pecan, also decline, and threeawn, buffalograss, red grama, annual grasses, other forbs, and mesquite invade. Mesquite continues to increase, along with western soapberry, black willow, and bumelia.

These soils provide excellent habitat for squirrels and deer and good nesting areas for doves, quail, turkeys, and songbirds. The trees, shrubs, and water attract fur bearing animals. These soils have excellent value, both as wildlife habitat and for cattle production. Wildlife are attracted to these soils because of the mast, seed producing forbs, winter annuals, and cover.

These soils have severe limitations for most urban uses. Flooding is the main limitation. Other limitations are the shrink-swell properties and low strength. These soils are moderately suited to most recreation uses. Flooding is a restriction for some playground and camping uses.

The soils in this association are in capability subclass Vw and in the Loamy Bottomland range site.

19—Gageby loam, occasionally flooded. This deep, nearly level soil is on flood plains along the major streams. Slopes are smooth and range from 0 to 1 percent. Areas are long and narrow and range from 10 to several hundred acres. Most areas of this soil are subject to flooding about once in every 3 to 10 years. Some areas, however, are rarely flooded because they are protected by flood-prevention structures.

Typically, this soil has a surface layer of calcareous loam about 29 inches thick. It is dark grayish brown in the upper 16 inches and brown in the lower 13 inches. The subsoil is friable, calcareous, brown loam to a depth of 60 inches.

This soil is well drained. Runoff is slow. The permeability is moderate, and the available water capacity is high. Natural fertility and organic matter content are high. The root zone is deep and easily penetrated by roots.

Included with this soil in mapping are small areas of Frio soils; areas of light colored, loamy soils that are next to the stream channels in most places; small areas of Nuvalde soils on the slightly higher elevations in some areas; and small areas of Gageby clay loam and Gageby sandy clay loam. The included soils make up as much as 20 percent of a mapped area.

This Gageby soil is used for cropland, pastureland, and rangeland. Small grain and grain sorghum are the main cultivated crops.

This soil is well suited to wheat, oats, forage sorghum, grain sorghum, and pecans (fig. 6).

Crop residue left on the surface helps to conserve moisture and maintain tilth and productivity.

This soil is well suited to the production of pasture. Pasture grasses, such as johnsongrass, coastal bermudagrass, and kleingrass, grow well.

The potential rangeland plant community is a mid and tall grass flood plain with scattered trees. The composition, by weight, is about 70 percent grasses, 10 percent forbs, and 20 percent woody plants.

The predominant plants are vine-mesquite, 15 percent; sideoats grama, 10 percent; switchgrass, 10 percent;

Figure 6.—A pecan orchard on Gageby loam, occasionally flooded.

Figure 7.—An area of Hext-Oplin-Brackett association, hilly.

little bluestem, 10 percent; and big bluestem, indiangrass, Texas needlegrass, Canada wildrye, and meadow dropseed, each 5 percent. Forbs, such as bundleflower, Maximilian sunflower, and Engelmann-daisy, make up 10 percent; and woody plants, such as hackberry, elm, live oak, and pecan, make up 20 percent.

Big bluestem, indiangrass, and switchgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as sideoats grama, Texas needlegrass, vine-mesquite, dropseed, silver bluestem, live oak, bumelia, and pecan. If heavy grazing continues, the less preferred plants, with the exception of live oak, bumelia, and pecan, also decline, and threeawn, buffalograss, red grama, annual grasses, other forbs, and mesquite invade. Mesquite continues to increase, along with western soapberry, black willow, and bumelia.

This soil provides excellent habitat for squirrels and deer and good nesting areas for doves, quail, turkeys, and songbirds. The trees, shrubs, and water attract fur bearing animals. This soil has excellent value, both as wildlife habitat and for cattle production. Wildlife are attracted to the soil because of the mast, seed producing forbs, winter annuals, and cover.

This soil has severe limitations for most urban uses because it is subject to flooding. Flooding also is a hazard for most recreation uses; for example, campsites and playgrounds.

This soil is in capability subclass IIw and in the Loamy Bottomland range site.

20—Hext-Oplin-Brackett association, hilly. This association is on strongly sloping to steep uplands, mainly on the sides of hills and ridges (fig. 7). Slopes range from 10 to 30 percent. Areas are mainly irregular

bands 100 to 600 feet wide that range from 20 to several hundred acres. The soils in this map unit formed in outliers of the cretaceous geological formation that extends into the county.

The Hext soil makes up about 35 percent of the association; Oplin soils, about 25 percent; Brackett soil, about 20 percent; and other soils, about 20 percent. The strongly sloping and moderately steep Hext soil is on the lower part of the hillslopes, Oplin soil is on the summits of hills and ridges, and the moderately steep and steep Brackett soil is mainly on the upper part of the hillslopes.

Typically, the Hext soil has a surface layer of light brownish gray loam about 7 inches thick. Calcareous sandstone fragments are widely scattered on the surface. The subsoil between a depth of 7 and 24 inches is light gray loam. The underlying material is weakly cemented sandstone that is brittle when dry and friable when moist (fig. 8). Reaction is moderately alkaline throughout.

Figure 8.—Hext soil in a roadcut in Hext-Oplin-Brackett association, hilly. This soil is underlain by soft sandstone.

Hext soil is well drained. Runoff is medium. The permeability is moderate, and the available water capacity is low. The root zone is moderately deep.

Typically, the Oplin soil has a surface layer of very dark grayish brown very cobbly clay loam about 17 inches thick. It is about 65 percent flat cobblestones and fragments of limestone gravel. The underlying material is fractured, indurated and platy, limestone bedrock.

Oplin soil is well drained. Runoff is rapid. The permeability is moderate, and the available water capacity is very low.

Typically, the Brackett soil has a surface layer of moderately alkaline, pale brown gravelly loam about 4 inches thick. The subsoil to a depth of 13 inches is moderately alkaline, light gray gravelly loam. Between a depth of 13 and 20 inches the underlying material is moderately alkaline, white, silty shale.

Brackett soil is well drained. Runoff is rapid. The permeability is moderately slow, and the available water capacity is very low. The root zone is shallow.

Included with this association in mapping are areas of rock outcrop and areas of soils that are similar to Hext soil but do not have sandstone layers within a depth of 40 inches. Also included are eroded areas of Hext, Oplin, and Brackett soils where sheet erosion has removed most of the surface layers and, in places, small areas of Cho, Mereta, and Throck soils. These soils make up about 20 percent of the map unit.

These Hext-Oplin-Brackett soils are not suitable for cultivation or for pastureland because of slope, stoniness, a shallow rooting depth, and susceptibility to water erosion. They are used mainly for rangeland and wildlife habitat.

The potential rangeland plant community on the Hext and Brackett soils is a mid and tall grass, Texas oak and live oak savannah. The composition, by weight, is about 80 percent grasses, 5 percent forbs, and 15 percent woody plants.

The predominant plants are little bluestem, 30 percent; sideoats grama, 15 percent; tall grama, 10 percent; indiangrass, 10 percent; and silver bluestem, hairy grama, and tall dropseed, each 5 percent. Forbs, such as wild alfalfa, dotted gayfeather, and trailing ratany, make up 5 percent; and woody plants, such as Texas oak and live oak, make up 15 percent.

Little bluestem, sideoats grama, and indiangrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as silver bluestem, tall dropseed, hairy grama, sideoats grama, queensdelight, and Texas oak. If heavy grazing continues, the less preferred plants, with the exception of Texas oak and queensdelight, also decline, and red grama, threeawn, other forbs, and juniper invade.

The potential rangeland plant community on the Oplin soil is a mid and tall grass, oak savannah. The composition, by weight, is about 75 percent grasses, 10 percent forbs, and 15 percent woody plants. Cattle graze

this soil very little because of the strong to steep slopes.

The predominant plants are sideoats grama, 30 percent; little bluestem, 20 percent; slim and rough tridens, 10 percent; and silver bluestem, green sprangletop, and indiangrass, each 5 percent. Forbs, such as bushsunflower, Engelmann-daisy, and halfshrub sundrop, make up 10 percent; and woody plants, such as live oak and Texas oak, make up 15 percent.

Little bluestem, sideoats grama, and indiangrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as silver bluestem, plains lovegrass, slim and rough tridens, dropseed, and skunkbush sumac. If heavy grazing continues, the less preferred plants, with the exception of skunkbush sumac, also decline, and threeawn, Texas needlegrass, hairy tridens, other forbs, prickly ash, and juniper invade. Live oak and Texas oak continue to increase, along with skunkbush sumac, juniper, and prickly ash.

These soils provide fair habitat for deer and fair nesting areas for doves, quail, turkeys, and songbirds. The rough terrain attracts fur bearing animals.

The main limitations of these soils for most urban and recreation uses are slope, depth to rock, and sandstone fragments and cobbles.

The soils in this association are in capability subclass VIIs. The Brackett soil and the Hext soil are in the Steep Adobe range site, and the Oplin soil is in the Steep Rocky range site.

21—Leeray clay, 0 to 1 percent slopes. This deep, nearly level soil is on uplands and in valleys. Slopes are smooth, and surfaces are slightly concave to plane. Areas are broad to irregular in shape and range from 10 to over 500 acres. In undisturbed areas, the surface is characterized by weak gilgai microrelief that consists of microknolls and microdepressions. The microknolls are 3 to 10 inches higher than the microdepressions. Evidence of gilgai microrelief is destroyed after a few years of cultivation.

Typically, this soil is moderately alkaline clay to a depth of about 59 inches. It is dark grayish brown in the upper part and brown in the lower part. The underlying material is light yellowish brown silty clay.

This soil is well drained. Runoff is slow. When this soil is dry, it has wide, deep cracks. Water enters the dry, cracked soil rapidly but enters very slowly when the soil is wet and the cracks are sealed. The permeability is very slow, and the available water capacity is medium. Natural fertility and organic matter content are moderately high.

Included with some areas of this soil in mapping are small areas of Nukrum, Rowena, and Sagerton soils. The included soils make up less than 20 percent of any one mapped area.

This Leeray soil is used mainly for cropland. Small grain and grain sorghum are the main cultivated crops.

This soil is well suited to wheat, oats, grain sorghum, and cotton. Crop residue left on the surface helps to conserve moisture and maintain tilth and productivity.

This soil is favored for grazing because of the smooth topography and good forage production. The potential rangeland plant community is a short and mid grass prairie. The composition, by weight, is about 90 percent grasses, 10 percent forbs, and traces of woody plants.

The predominant plants are sideoats grama, 25 percent; vine-mesquite, 15 percent; silver bluestem, 10 percent; Arizona cottontop, 10 percent; buffalograss, 10 percent; Texas needlegrass, 10 percent; western wheatgrass, 5 percent; and white tridens, 5 percent. Forbs, such as Engelmann-daisy, heath aster, bundleflower, and catclaw sensitivebrier, make up 10 percent. There is a trace of such woody plants as elm and hackberry.

Sideoats grama, vine-mesquite, Arizona cottontop, and western wheatgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, mainly buffalograss, silver bluestem, Texas needlegrass, and dropseed. If heavy grazing continues, the less preferred plants, with the exception of Texas needlegrass and buffalograss, also decline, and threeawn, hairy tridens, Texas grama, other forbs, mesquite, tasajillo, and pricklypear invade. Mesquite continues to increase, along with lotebush and pricklypear.

This soil provides only fair nesting areas for doves, quail, and songbirds. It has limited value for wildlife habitat because of the absence of woody plants for cover and food.

This soil is well suited to pastureland. Improved bermudagrass and kleingrass are commonly grown.

The main limitations of this soil for most urban and recreation uses are shrinking and swelling with changes in moisture content, low strength, corrosivity to uncoated steel, and a clayey surface layer. These limitations can be overcome, however, with proper design and installation.

This soil is in capability subclass IIIs and in the Clay Loam range site.

22—Leeray clay, 1 to 3 percent slopes. This deep, gently sloping soil is on uplands. Surfaces are slightly convex to plane. Slopes average about 2 percent. Areas are irregular in shape and range from 10 to 500 acres. In undisturbed areas, the surface has weak gilgai microrelief that is made up of microknolls and microdepressions. The microknolls are 3 to 10 inches higher than the microdepressions. Evidence of gilgai microrelief is destroyed after a few years of cultivation.

Typically, this soil is moderately alkaline clay to a depth of 65 inches. The upper part is dark grayish

brown, the middle part is grayish brown and brown, and the lower part is dark brown.

This soil is well drained. Runoff is medium. When this soil is dry, it has wide, deep cracks. Water enters the soil rapidly when it is dry and cracked but enters very slowly when the soil is wet and the cracks have sealed. The permeability is very slow, and the available water capacity is medium. Natural fertility and organic matter content are moderately high.

Included with this soil in mapping are small areas of Nukrum, Rowden, Rowena, and Sagerton soils. Also included are a few very small areas of a soil that is similar to Leeray soil but has limestone bedrock at a depth of about 40 inches. The included soils make up less than 20 percent of the map unit.

This Leeray soil is used mainly for cropland. Small grain and grain sorghum are the main cultivated crops.

This soil is well suited to wheat, oats, grain sorghum, and cotton. Crop residue left on the surface helps to conserve moisture and maintain tilth and productivity. Contour farming and terracing are needed in most areas to prevent water erosion. Grassed waterways provide good outlets for terrace systems where excess water is a concern.

This soil is moderately suited to pastureland. Improved grasses, such as coastal bermudagrass and kleingrass, are commonly grown.

This soil is favored for grazing because of the smooth topography and good forage production. The potential rangeland plant community is a short and mid grass prairie. The composition, by weight, is about 90 percent grasses, 10 percent forbs, and a trace of woody plants.

The predominant plants are sideoats grama, 25 percent; vine-mesquite, 15 percent; silver bluestem, 10 percent; Arizona cottontop, 10 percent; buffalograss, 10 percent; Texas needlegrass, 10 percent; western wheatgrass, 5 percent; white tridens, 5 percent; and forbs, such as Engelmann-daisy, heath aster, bundleflower, and catclaw sensitivebrier, 10 percent. There is a trace of such plants as elm and hackberry.

Sideoats grama, vine-mesquite, Arizona cottontop, and western wheatgrass, which are preferred plants, are grazed out first by continuous heavy grazing. These plants are replaced by less preferred plants, mainly buffalograss, silver bluestem, Texas needlegrass, and dropseed. If heavy grazing continues, the less preferred plants, with the exception of Texas needlegrass and buffalograss, also decline, and threeawn, hairy tridens, Texas grama, other forbs, mesquite, tasajillo, and pricklypear invade. Mesquite continues to increase, along with lotebush and pricklypear.

This soil provides only fair nesting places for doves, quail, and songbirds. The absence of woody plants for food and cover is a limitation for most wildlife habitat.

This soil has severe limitations for urban and recreation uses. Shrinking and swelling with changes in moisture content, low strength, corrosivity to uncoated steel, and the clayey surface layer are the main limiting features. These limitations can be overcome, however, with proper design and installation.

This soil is in capability subclass IIIe and in the Clay Loam range site.

23—Lueders-Speck association, undulating. This association is on stony uplands, mainly on plateaus and ridges. Slopes are dominantly 1 to 8 percent. Areas are irregular in shape and range from 20 to several hundred acres.

The Lueders soil makes up about 45 percent of the association; Speck soil, about 30 percent; and other soils, about 25 percent. Areas of this map unit are large,

Figure 9.—Profile of Lueders cobbly clay loam in Lueders-Speck association, undulating. Depths are shown in centimeters (c) and feet (f). Multiply the figure on the left by 10 to determine the depth in centimeters.

and the composition is variable. However, the detail is adequate for the foreseeable uses of these soils.

The Lueders soil is on gently sloping and sloping ridges and knolls. Typically, the surface layer is about 14 inches thick. It is dark grayish brown, cobbly clay loam that grades to very cobbly clay loam in the lower part. This layer rests abruptly on a thick layer of light gray, fractured limestone (fig. 9).

Lueders soil is well drained. Runoff is rapid. The permeability is moderate, and the available water capacity is very low.

The Speck soil is mainly on the gently sloping ridgetops. Typically, the surface layer is mildly alkaline, dark brown stony clay loam about 5 inches thick. The subsoil between a depth of 5 and 15 inches is moderately alkaline, dark reddish brown clay that is about 10 percent, by volume, limestone cobbles in the lower part. This layer rests abruptly on a thick layer of fractured limestone bedrock. In some areas a closely similar soil is associated with the Speck soil. It has an accumulation of carbonates on the limestone bedrock but does not have an accumulation of clay in the subsoil.

Speck soil is well drained. Runoff is medium. The permeability is slow, and the available water capacity is very low.

Included with this association in mapping are areas of Throck, Cho, Mereta, and Rowden soils and areas of rock outcrop. Also included are areas of a soil similar to the Lueders soil that is clayey and less cobbly and small areas of strongly sloping Lueders and Throck soils. The included soils make up about 25 percent of a mapped area.

These Leuders-Speck soils are generally not suited to cultivated crops and pastures because they are too stony or too shallow. A few areas of soils are arable, but they are so small and irregular in shape that cultivation is impractical. These soils are best suited to and are used for rangeland (fig. 10).

The potential rangeland plant community on the Lueders soil is a mid and short grass prairie with scattered live oak. The composition, by weight, is 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

The predominant plants are sideoats grama, 30 percent; slim and rough tridens, 15 percent; buffalograss and curly mesquite, 15 percent; hairy dropseed, 10 percent; Texas needlegrass, 10 percent; silver bluestem, 5 percent; and little bluestem, 5 percent. Forbs, such as prairie-clover, dotted gayfeather, and Engelmann-daisy, make up 5 percent; and woody plants such as live oak make up 5 percent.

Little bluestem, sideoats grama, and slim tridens, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as Texas needlegrass, silver bluestem, buffalograss, curly mesquite, and dropseed. If heavy grazing continues, the less preferred plants also decline, and threeawn, hairy tridens, fall witchgrass, red grama, and pricklypear invade.

Figure 10.—Are area of rangeland in Lueders-Speck association, undulating. Lueders cobbly clay loam, in the foreground, is in the Very Shallow range site.

The Speck soil has high value for livestock production. The potential rangeland plant community is a mid grass, live oak prairie. The composition, by weight, is about 85 percent grasses, 5 percent forbs, and 10 percent woody plants.

The predominant plants are little bluestem, 20 percent; sideoats grama, 15 percent; Texas cupgrass, 10 percent; tall dropseed, 10 percent; and indiangrass, big bluestem, silver bluestem, Texas needlegrass, buffalograss, and Canada wildrye, each 5 percent. Forbs, such as prairie-clover, Engelmann-daisy, and bushsunflower, make up 5 percent. Woody plants such as live oak make up 5 percent of the composition, and hackberry and bumelia make up 5 percent.

Little bluestem, sideoats grama, and Texas cupgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as tall dropseed, silver bluestem, buffalograss, catclaw, and prickly ash. If heavy grazing continues, the less preferred plants, with the exception

of catclaw and prickly ash, also decline, and threeawn, Texas grama, other forbs, and mesquite invade. Prickly ash continues to increase, along with mesquite, tasajillo, pricklypear, and catclaw.

These soils provide habitat for deer and good nesting areas for doves, quail, turkeys, and songbirds.

These soils have severe limitations for most urban and recreation uses. Depth to limestone bedrock, the stony surface layers, and corrosivity to uncoated steel are the most limiting features.

The Lueders soil in this association is in capability subclass VIIs and in the Very Shallow range site. The Speck soil is in capability subclass VIs and in the Redland range site.

24—Mereta clay loam, 1 to 3 percent slopes. This shallow, gently sloping, calcareous soil is on uplands, mainly along slightly convex ridges. Slopes are smooth and average about 2 percent. Areas are elongated to irregular in shape and range from 10 to more than 150 acres.

Typically, the surface layer is moderately alkaline, dark brown clay loam about 16 inches thick. It rests abruptly on a layer of strongly cemented, pinkish white caliche about 6 inches thick. Between a depth of 22 and 60 inches the underlying material is friable, pink loam.

This soil is well drained. Runoff is medium. The permeability is moderately slow, and the available water capacity is very low. The rooting zone is shallow.

Included with some areas of this soil in mapping are small areas of Nuvalde, Cho, Sagerton, and Speck soils. Also included are small areas of nearly level Mereta soils and areas of a soil that is similar to Mereta soil but has a layer of strongly cemented caliche at a depth below 20 inches. The included soils make up less than 25 percent of a mapped area.

This Mereta soil can be cultivated, but it is used mainly as rangeland.

This soil is moderately suited to cool-season grain crops, such as oats and wheat. Yields of grain sorghum are generally low. Crop residue left on the surface helps to prevent water erosion and conserve moisture. It also improves tilth and water intake.

Pasture forage yields on this soil are generally low. Introduced grasses, such as kleingrass, coastal bermudagrass, and King Ranch bluestem, are best suited.

The potential rangeland plant community is a mid and short grass prairie. The composition, by weight, is 80 percent grasses, 10 percent forbs, and 10 percent woody plants.

The predominant plants are sideoats grama, 25 percent; buffalograss, 15 percent; slim tridens, 10 percent; and Wright threeawn, reverchon panicum, cane bluestem, Arizona cottontop, green sprangletop, and Texas needlegrass, each 5 percent. Forbs, such as dotted gayfeather, Engelmann-daisy, and orange zexmania, make up 10 percent. Woody plants such as live oak make up 5 percent of the composition, and hackberry and catclaw make up 5 percent.

Sideoats grama and green sprangletop, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by Wright threeawn, buffalograss, Texas needlegrass, slim tridens, Arizona cottontop, lotebush, and catclaw. If heavy grazing continues, all of the less preferred plants, with the exception of lotebush and catclaw, decline, and threeawn, Texas grama, red grama, other forbs, and mesquite and lotebush invade. Mesquite continues to increase, along with catclaw, prickly ash, pricklypear, and yucca.

This soil provides fair habitat for deer and fair nesting areas for doves, quail, turkeys, and songbirds. The rolling terrain attracts fur bearing animals.

The main limitations of this soil for urban and recreation uses are the limited depth to rock and shrinking and swelling with changes in moisture content.

This soil is in capability subclass IIIe and in the Shallow range site.

25—Nukrum clay, 1 to 3 percent slopes. This deep, gently sloping, calcareous soil is on uplands, in valleys, and on terraces. Slopes are smooth and average less than 2 percent. Surfaces are slightly concave to plane. Areas are long and narrow to irregular in shape and range from 10 to 450 acres.

Typically, the surface layer is moderately alkaline, dark grayish brown clay to a depth of 39 inches. The subsoil is moderately alkaline, grayish brown clay to a depth of 65 inches. Between a depth of 65 and 70 inches the underlying material is pale brown clay.

This soil is well drained. Runoff is medium. When this soil is dry, cracks extend from the surface to a depth of more than 20 inches. The permeability is slow, and the available water capacity is high. Natural fertility and organic matter content are high.

Included with some areas of this soil in mapping are small areas of Leeray, Rowena, Sagerton, Nuvalde, and Frio soils. Also included are areas of nearly level Nukrum clay, and a few areas of Nukrum clay loam, Nukrum silty clay loam, and Nukrum silty clay. The included soils make up as much as 20 percent of a mapped area.

This Nukrum soil is used for cropland, pastureland, and rangeland. Small grain and grain sorghum are the main cultivated crops.

This soil is well suited to oats, wheat, grain sorghum, and cotton. Crop residue left on the surface helps to conserve moisture and maintain tilth and productivity. Contour farming and terracing are needed in most areas to prevent water erosion. Grassed waterways provide good outlets for terrace systems where excess water is a concern.

This soil is well suited to pastureland. Introduced grasses, such as coastal bermudagrass, kleingrass, King Ranch bluestem, and weeping lovegrass, grow well.

This soil is favored for grazing because of the smooth topography and good forage production. The potential

rangeland plant community is a short and mid grass prairie. The composition, by weight, is about 90 percent grasses, 10 percent forbs, and traces of woody plants.

The predominant plants are sideoats grama, 25 percent; vine-mesquite, 15 percent; silver bluestem, 10 percent; Arizona cottontop, 10 percent; buffalograss, 10 percent; Texas needlegrass, 10 percent; western wheatgrass, 5 percent; and white tridens, 5 percent. Forbs, such as Engelmann-daisy, heath aster, bundleflower, and catclaw sensitivebrier, make up 10 percent. There is a trace of such woody plants as elm and hackberry.

Sideoats grama, vine-mesquite, Arizona cottontop, and western wheatgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, mainly buffalograss, silver bluestem, Texas needlegrass, and dropseed. If heavy grazing continues, the less preferred plants, with the exception of Texas needlegrass and buffalograss, also decline, and threeawn, hairy tridens, Texas grama, other forbs, mesquite, tasajillo, and pricklypear invade. Mesquite continues to increase, along with lotebush and pricklypear.

The soil provides only fair nesting areas for doves, quail, and songbirds. The absence of woody plants limits this soil as habitat for wildlife.

The main limitations of this soil for most urban and recreation uses are shrinking and swelling with changes in moisture content, low strength, corrosivity to uncoated steel, and a clayey surface layer. These limitations can be overcome by proper design and installation.

This soil is in capability subclass IIe and in the Clay Loam range site.

26—Nukrum clay, 3 to 5 percent slopes. This deep, gently sloping, calcareous soil is on uplands, in valleys, and on terraces. Slopes are smooth and average about 4 percent. Surfaces are slightly concave to plane. Areas are long and narrow to irregular in shape and range from 10 to several hundred acres.

Typically, the surface layer is clay about 27 inches thick. It is dark grayish brown in the upper part and dark brown in the lower part. The subsoil between a depth of 27 and 56 inches is brown clay. The underlying material to a depth of 75 inches is light yellowish brown clay loam.

This soil is well drained. Runoff is medium. When this soil is dry, cracks extend from the surface to a depth of more than 20 inches. The permeability is slow, and the available water capacity is high. Natural fertility and organic matter content are high.

Included with this soil in mapping are small areas of Callahan, Frio, Rowena, Leeray, and Throck soils. Also included are a few areas of a soil that is similar to Nukrum soil but has a thinner surface layer and areas of Nukrum clay loam, Nukrum silty clay loam, and Nukrum silty clay. The included soils make up as much as 20 percent of a mapped area.

This Nukrum soil is used for rangeland, pastureland, and cropland. Wheat and oats are the main cultivated crops.

This soil is moderately suited to oats, wheat, grain sorghum, and cotton. Crop residue left on the surface helps to conserve moisture and maintain tilth and productivity. Contour farming and terracing are needed in most areas to prevent water erosion. Grassed waterways provide good outlets for terrace systems where excess water is a concern.

This soil is moderately suited to pastureland. Introduced grasses, such as coastal bermudagrass, kleingrass, King Ranch bluestem, and weeping lovegrass are suited.

This soil is favored for grazing because of the smooth topography and good forage production. The potential rangeland plant community is a short and mid grass prairie. The composition, by weight, is about 90 percent grasses, 10 percent forbs, and traces of woody plants.

The predominant plants are sideoats grama, 25 percent; vine-mesquite, 15 percent; silver bluestem, Arizona cottontop, buffalograss, and Texas needlegrass, each 10 percent; and western wheatgrass and white tridens, each 5 percent. Forbs, such as Engelmann-daisy, heath aster, bundleflower, and catclaw sensitivebrier, make up 10 percent. There is a trace of such woody plants as elm and hackberry.

Sideoats grama, vine-mesquite, Arizona cottontop, and western wheatgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, mainly buffalograss, silver bluestem, Texas needlegrass, and dropseed. If heavy grazing continues, the less preferred plants, with the exception of Texas needlegrass and buffalograss, also decline, and hairy tridens, Texas grama, other forbs, mesquite, tasajillo, and pricklypear invade. Mesquite continues to increase, along with lotebush and pricklypear.

This soil provides fair nesting areas for doves, quail, and songbirds. It is limited as a habitat for wildlife because of the absence of woody plants.

The main limitations of this soil for most urban or recreation uses are shrinking and swelling with changes in moisture content, low strength, corrosivity to uncoated steel, and the clayey surface layer. These limitations can be overcome with proper design and installation.

This soil is in capability subclass IIIe and in the Clay Loam range site.

27—Nuvalde clay loam, 1 to 3 percent slopes. This deep, calcareous, gently sloping soil is on uplands, mainly in the shallow valleys and on terraces. Slopes are smooth and average about 2 percent. Surfaces are slightly concave to plane. Areas are oblong to irregular in shape and range from 10 to several hundred acres.

Typically, the surface layer is moderately alkaline, dark grayish brown clay loam 15 inches thick. The subsoil to a depth of 49 inches is moderately alkaline clay loam

that is grayish brown in the upper part and brown in the lower part. The underlying material to a depth of 60 inches is pale brown clay loam (fig. 11).

This soil is well drained. Runoff is slow. The permeability is moderate, and the available water capacity is high. Natural fertility and organic matter content are moderate.

Included with this soil in mapping are small areas of Abilene, Gageby, Nukram, Rowena, and Sagerton soils. Also included are areas of Nuvalde loam, areas of nearly level Nuvalde soils, and areas of a soil that is closely similar to the Nuvalde soil but has a weak accumulation of carbonates in the lower part of the subsoil. These soils make up as much as 25 percent of a mapped area.

This Nuvalde soil is used mainly for cropland or improved pasture. Oats, wheat, and forage sorghum are the main crops, but other crops are grown. A few areas are used for rangeland.

Figure 11.—Profile of Nuvalde clay loam, 1 to 3 percent slopes.

This soil is moderately suited to oats, wheat, grain sorghum, forage sorghum, and cotton. Terracing and contour farming help to control water erosion. Crop residue left on the surface helps to conserve moisture and maintain tilth and productivity.

This soil is well suited to pastureland. Introduced grasses, such as kleingrass, improved bermudagrass, King Ranch bluestem, and weeping lovegrass, are commonly grown.

This soil is favored for grazing because of the smooth topography and good forage production. The potential rangeland plant community is a short and mid grass prairie. The composition, by weight, is about 90 percent grasses, 10 percent forbs, and traces of woody plants.

The predominant plants are sideoats grama, 25 percent; vine-mesquite, 15 percent; silver bluestem, 10 percent; Arizona cottontop, 10 percent; buffalograss, 10 percent; Texas needlegrass, 10 percent; western wheatgrass, 5 percent; and white tridens, 5 percent. Forbs, such as Engelmann-daisy, heath aster, bundleflower, and catclaw sensitivebrier, make up 10 percent. There is a trace of such woody plants as elm, live oak, and hackberry.

Sideoats grama, vine-mesquite, Arizona cottontop, and western wheatgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, mainly buffalograss, silver bluestem, Texas needlegrass, and dropseed. If heavy grazing continues, the less preferred plants, with the exception of Texas needlegrass and buffalograss, also decline, and threeawn, hairy tridens, Texas grama, other forbs, mesquite, tasajillo, and pricklypear invade. Mesquite continues to increase, along with lotebush and pricklypear.

This soil provides fair nesting areas for doves, quail, and songbirds.

This soil has few limitations for urban and recreation uses. Low strength and corrosivity to uncoated steel are the main limiting features.

This soil is in capability subclass IIe and in the Clay Loam range site.

28—Oplin-Speck association, undulating. This association is on stony uplands, mainly on plateaus and limestone ridges. Slopes range from 1 to 8 percent but average about 3 percent. Areas are irregular in shape and range from 20 to several hundred acres. The soils in this map unit formed in outliers of the cretaceous geological formation that extends into the county.

The Oplin soils make up about 60 percent of the association; Speck soils, about 20 percent; and other soils, about 20 percent. The areas of this map unit are large, and the composition is variable. However, the detail is adequate for the foreseeable uses of the soils.

The Oplin soil is mainly on small knolls and slopes on the outer edges of the mapped areas. Typically, the surface layer is moderately alkaline, brown, very flaggy clay loam about 9 inches thick. The underlying material is fractured limestone.

Oplin soil is well drained. Runoff is medium to rapid. The permeability is moderate, and the available water capacity is very low.

The gently sloping Speck soil is mainly on the ridgetops. Typically, the surface layer is dark brown, cobbly clay loam about 6 inches thick. Between a depth of 6 and 14 inches the subsoil is moderately alkaline, reddish brown clay that is about 20 percent, by volume, limestone cobbles. The underlying material is fractured, limestone bedrock.

Speck soil is well drained. Runoff is medium. The permeability is slow, and the available water capacity is very low.

Included with this association in mapping are a few areas of Cho and Brackett soils. Also included is a soil similar to the Speck soil but is less than 10 inches to bedrock and a soil on foot slopes and in concave areas that does not have stones on the surface. There are a few areas of strongly sloping Oplin and Speck soils and a few outcrops of rock. The included soils and rock outcrops average about 20 percent of each mapped area.

These Oplin-Speck soils are too stony or too steep for cultivated crops. They are best suited to rangeland.

The potential rangeland plant community on the Oplin soil is a mid grass, live oak savannah. The composition, by weight, is about 75 percent grasses, 10 percent forbs, and 15 percent woody plants.

The predominant plants are sideoats grama, 25 percent; little bluestem, 10 percent; buffalograss, 10 percent; and big bluestem, silver bluestem, Canada wildrye, fall witchgrass, Texas needlegrass, and Wright threeawn, each 5 percent. Forbs, such as Engelmann-daisy, bush sunflower, and dotted gayfeather, make up 10 percent. Woody plants, such as live oak and shinnery oak, make up 10 percent and 5 percent, respectively.

Little bluestem, big bluestem, sideoats grama, and Canada wildrye, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by an increase of less preferred plants, such as Texas needlegrass, silver bluestem, buffalograss, slim tridens, Wright threeawn, live oak, and shinnery oak. If heavy grazing continues, the less preferred plants, with the exception of live oak and shinnery oak, also decline, and red grama, Texas grama, hairy tridens, other forbs, juniper, and pricklypear invade. Live oak continues to increase, along with pricklypear, catclaw, juniper, and prickly ash.

This Speck soil has high value for livestock production. The potential rangeland plant community is a mid grass, live oak prairie. The composition, by weight, is about 85 percent grasses, 5 percent forbs, and 10 percent woody plants.

The predominant plants are little bluestem, 20 percent; sideoats grama, 15 percent; Texas cupgrass, 10 percent; tall dropseed, 10 percent; and indiangrass, big bluestem, silver bluestem, Texas needlegrass, buffalograss, and Canada wildrye, each 5 percent. Forbs, such as prairie-clover, Engelmann-daisy, and bushsunflower, make up 5 percent. Woody plants such as live oak make up 5 percent of the composition, and hackberry and bumelia make up 5 percent.

Little bluestem, sideoats grama, and Texas cupgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as tall dropseed, silver bluestem, buffalograss, catclaw, and prickly ash. If heavy grazing continues, the less preferred plants, with the exception of catclaw and prickly ash, also decline, and threeawn, Texas grama, other forbs, and mesquite invade. Prickly ash continues to increase, along with mesquite, tasajillo, pricklypear, and catclaw.

These soils provide good habitat for deer and good nesting areas for doves, quail, turkeys, and songbirds. Some areas of Oplin soil attract fur bearing animals.

These soils have severe limitations for most urban and recreation uses. Depth to limestone bedrock, a stony surface layer, and corrosivity to uncoated steel are the most limiting features.

The Oplin soil is in capability subclass VIIs and in the Low Stony Hills range site. The Speck soil is in capability subclass VIs and in the Redland range site.

29—Owens-Throck association, hilly. These strongly sloping to steep soils are on uplands, mainly in bands around hills. Areas are long and narrow and range from 10 to several hundred acres. Fragments of limestone and sandstone as much as 48 inches in diameter cover 5 to about 20 percent of the surface. Geological erosion is active within these areas. Gullies, 1 to 10 feet wide and 1 to 5 feet deep, commonly dissect the areas at intervals of 10 to 100 feet. Slopes range from 10 to about 30 percent.

Owens and closely similar soils make up about 50 percent of this association; Throck soil, about 35 percent; and other soils, about 15 percent. The Owens soil is in gullies and on adjoining slopes, and the Throck soil is mainly on uneroded side slopes and foot slopes. Areas of this map unit are large, and the composition is variable. However, the detail is adequate for the foreseeable uses of the soils.

Typically, the Owens soil has a surface layer of moderately alkaline, brown stony clay about 3 inches thick. The subsoil to a depth of 17 inches is moderately alkaline clay. It is brownish in the upper part and grayish in the lower part. The underlying material is grayish shaly clay. In some areas there is a closely similar soil that has shaly clay at a depth of less than 10 inches, and in other areas there is a similar soil that has shaly clay at a depth of more than 20 inches.

Owens soil is well drained. Runoff is rapid. The permeability is very slow, and the available water capacity is very low. The root zone is shallow.

The Throck soil has a surface layer of moderately alkaline, brown stony clay loam about 4 inches thick. The subsoil between a depth of 4 and 24 inches is light

brownish yellow silty clay. The underlying material is light gray shaly clay. Included with the Throck soil is a closely similar soil that does not have the prominent accumulations of calcium carbonate in the lower part of the subsoil.

Throck soil is well drained. Runoff is medium to rapid. The permeability is slow, and the available water capacity is medium.

Included with this association in mapping are small areas of Callahan and Nukrum soils, areas of gently sloping and sloping Owens and Throck soils on foot slopes, and areas of shallow and very shallow soils that are underlain by limestone. Some areas have boulders on the higher slopes, and a few areas are badlands. These soils and areas of badlands make up an average of 15 percent of a mapped area.

These Owens-Throck soils are used for rangeland and for wildlife habitat. They are not suited to cropland or pastureland because of the slope, depth to shaly clay, and stones on the surface.

The potential rangeland plant community is a mid and tall grass prairie. The composition, by weight, is about 85 percent grasses, 10 percent forbs, and 5 percent woody plants.

The predominant plants are little bluestem, 15 percent; sideoats grama, 15 percent; Texas cupgrass, 10 percent; hairy dropseed, 10 percent; and indiangrass, Canada wildrye, cane bluestem, Texas needlegrass, buffalograss, rough tridens, and big bluestem, each 5 percent. Forbs, such as Engelmann-daisy, bundleflower, dotted gayfeather, and heath aster, make up 10 percent; and woody plants, such as hackberry, elm, and elbowbush, make up 5 percent.

Little bluestem, indiangrass, big bluestem, and Canada wildrye, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as sideoats grama, cane bluestem, dropseed, Texas needlegrass, and elbowbush. If heavy grazing continues, the less preferred plants, with the exception of elbowbush, also decline, and threeawn, hairy tridens, red grama, other forbs, and mesquite invade. Mesquite continues to increase, along with lotebush, tasajillo, pricklypear, and skunkbush sumac.

These soils provide fair habitat for deer and fair nesting areas for doves, quail, and songbirds. The rough terrain attracts fur bearing animals.

These soils have severe limitations for most urban and recreation uses. Slope, the hazard of erosion, shrinking and swelling with changes in moisture content, very slow permeability, low strength, and the stony or gravelly surface layers are the main limitations.

The soils in this association are in capability subclass VIIs and in the Rocky Hills range site.

30—Pedernales loamy fine sand, 1 to 3 percent. This deep, gently sloping, sandy soil is on uplands. Slopes are slightly convex and average about 2 percent. Areas range from irregular in shape to broad and expansive. They range from 10 to several hundred acres.

Typically, the surface layer is brownish loamy fine sand about 12 inches thick. The subsoil between a depth of 12 and 40 inches is sandy clay that is yellowish red in the upper part and reddish yellow in the lower part. The subsoil between a depth of 40 and 55 inches is light reddish brown clay loam. The underlying layer to a depth of 70 inches is brownish to reddish clay loam. Reaction is typically mildly alkaline in the upper part and moderately alkaline in the lower part.

This soil is well drained. Runoff is high. The permeability is moderately slow, and the available water capacity is medium. The hazard of soil blowing is severe.

Included with this soil in mapping are areas of Chaney and Cisco soils and a soil similar to Pedernales soil that does not have carbonates within a depth of 60 inches. Also included are areas of a soil that has a sandy surface layer more than 20 inches thick and areas of eroded soils that have a thin surface layer of loamy fine sand that was mixed with the clayey subsoil when it was tilled. The included soils make up less than 20 percent of a mapped area.

Most areas of this Pedernales soil are cultivated or used for pastureland. The main crops are peanuts and grain sorghum.

This soil is well suited to peanuts and moderately suited to grain sorghum. Peaches, apples, and melons are also well suited to this soil. Crop residue left on the surface helps to conserve moisture, control soil blowing, and maintain tilth. Contour farming and terracing are needed in most areas to prevent water erosion.

This soil is well suited to pastureland. Introduced grasses, such as coastal bermudagrass and weeping lovegrass, grow well on this soil.

The potential rangeland plant community is a mid and tall grass, post oak savannah. The species composition, by weight, is about 80 percent grasses, 5 percent forbs, and 15 percent woody plants (fig. 12).

The predominant plants are little bluestem, 30 percent; indiangrass, 10 percent; sand lovegrass, 10 percent; and big bluestem, purpletop tridens, sideoats grama, silver bluestem, tall dropseed, and Canada wildrye, each 5 percent. Forbs, such as Maximilian sunflower, bundleflower, and Engelmann-daisy, make up 5 percent. Woody plants, such as post oak and blackjack oak, make up 10 percent and 5 percent, respectively.

Little bluestem, indiangrass, and sand lovegrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by the less preferred plants, such as sideoats grama, silver bluestem, dropseed, hooded windmillgrass, skunkbush sumac, and post oak. If heavy grazing continues, the less preferred plants, with the exception of post oak and skunkbush sumac, also decline, and threeawn, low panicum, lovegrass, other forbs, prickly ash, and greenbrier invade. Post oak continues to increase, along with blackjack oak, shinnery oak, greenbrier, and skunkbush sumac.

This soil provides good habitat for deer and good nesting areas for doves, quail, turkeys, and songbirds.

Figure 12.—An area of range in Pedernales loamy fine sand, 1 to 3 percent slopes. This Loamy Sand range site shows the recovery of native tall grass following mechanical brush control and deferred grazing.

The woody cover attracts fur bearing animals.

The main limitations of this soil for urban and recreation uses are shrinking and swelling upon wetting and drying and a sandy surface layer. Low strength is a limitation for local roads and streets.

This soil is in capability subclass IIIe and in the Loamy Sand range site.

31—Pedernales fine sandy loam, 1 to 3 percent slopes. This deep, gently sloping soil is in slightly convex areas on uplands. Slopes are smooth and average about 2 percent. Areas are irregular in shape and range from 10 to several hundred acres.

Typically, the surface layer is brown fine sandy loam about 7 inches thick. The subsoil extends to a depth of 53 inches. It is red sandy clay to a depth of 40 inches and red, calcareous sandy clay loam to a depth of 53 inches. The underlying layer is reddish yellow, calcareous sandy clay loam to a depth of 70 inches. Reaction is typically mildly alkaline in the upper part and moderately alkaline in the lower part.

This soil is well drained. Runoff is medium. The permeability is moderately slow, and the available water capacity is high. The hazard of soil blowing is moderate.

Included with some areas of this soil in mapping are areas of Abilene, Cisco, Callahan, and Chaney soils.

Also included are areas of a similar soil in which the subsoil extends to a depth of more than 60 inches. The included soils make up less than 15 percent of a mapped area.

This Pedernales soil is used as cropland, rangeland, orchards, and pastureland. The main crops are oats, peanuts (fig. 13), grain sorghum, and forage sorghum (fig. 14).

This soil is moderately suited to peanuts, grain sorghum, and forage sorghum. Crop residue left on the surface helps to conserve moisture, control soil blowing, and maintain tilth (fig. 15). Terracing and contour farming

Figure 13.—Peanuts on Pedernales fine sandy loam, 1 to 3 percent slopes.

Figure 14.—Forage sorghum in a field of Pedernales fine sandy loam, 1 to 3 percent slopes.

help to control water erosion. Peaches and apples are also suited to this soil.

This soil is well suited to pastureland. Kleingrass, weeping lovegrass, and coastal bermudagrass grow well.

The potential rangeland plant community is a mid grass, post oak savannah. The composition, by weight, is about 75 percent grasses, 10 percent forbs, and 15 percent woody plants. Cattle graze this soil often because of the variety and palatability of the forage species.

The predominant plants are sideoats grama, 15 percent; little bluestem, 10 percent; vine-mesquite, 10 percent; Texas needlegrass, 10 percent; and Arizona cottontop, hooded windmillgrass, silver bluestem,

Figure 15.—Oat stubble left on Pedernales fine sandy loam, 1 to 3 percent slopes. The crop residue reduces soil erosion.

Canada wildrye, buffalograss, and sand dropseed, each 5 percent. Forbs, such as prairie-clover, Engelmann-daisy, and heath aster, make up 10 percent. Woody plants, such as post oak and skunkbush sumac, make up 10 percent and 5 percent, respectively.

Little bluestem, indiangrass, and Canada wildrye, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as sideoats grama, silver bluestem, Arizona cottontop, Texas needlegrass, hooded windmillgrass, skunkbush sumac, and post oak. If heavy grazing continues, the less preferred plants, with the exception of post oak and skunkbush sumac, also decline, and threeawn, low panicums, tumble lovegrass, other forbs, and mesquite invade. Post oak continues to increase, along with greenbrier, elm, mesquite, and skunkbush sumac.

This soil provides good habitat for deer and good nesting areas for doves, quail, turkeys, and songbirds. The hollow trees attract fur bearing animals.

The main limitations of this soil for most urban and recreation uses are low strength, moderate shrinking and swelling with changes in moisture content, and the clayey subsoil. These limitations can be overcome by good design and careful installation.

This soil is in capability subclass IIe and in the Tight Sandy Loam range site.

32—Pedernales fine sandy loam, 1 to 3 percent slopes, eroded. This deep, gently sloping, eroded soil is on uplands. Slopes are convex and average about 2.5 percent. Areas are irregular in shape and range from 10 to several hundred acres. Sheet erosion has removed 25 to 75 percent of the original surface layer, and shallow gullies with sloping sides occur at intervals of 50 to 200 feet in most areas. Erosion of the surface layer has not been uniform. The plow layer in most places is fine sandy loam, but it is sandy clay loam or loamy fine sand in parts of some mapped areas.

Typically, the surface layer is brown fine sandy loam about 6 inches thick. The subsoil extends to a depth of 45 inches. It is red sandy clay to a depth of 30 inches and reddish yellow sandy clay loam between a depth of 30 and 45 inches. The underlying layer to a depth of 55 inches is weakly cemented, white clay loam.

This soil is well drained. Runoff is medium. The permeability is moderately slow, and the available water capacity is high.

Included with this soil in mapping are areas of Callahan, Chaney, Cisco, and Hext soils. Also included are a few areas that have slopes of more than 3 percent. The included soils make up as much as 25 percent of a mapped area.

This Pedernales soil is suitable for cultivation, but it is used mainly for pastureland because of severe erosion and low productivity. Some areas are used for rangeland.

This soil is moderately suited to pastureland. Pasture grasses, such as King Ranch bluestem, kleingrass, weeping lovegrass, and coastal bermudagrass, are suited to this soil.

This soil is well suited to forage sorghum, grain sorghum, oats, and peanuts. Crop residue left on the surface helps to conserve moisture, control soil blowing, and maintain tilth. Terracing and contour farming help to control water erosion. Past erosion has reduced organic matter content and fertility and has caused lower crop yields.

Cattle graze this soil often because of the variety and palatability of the forage species. The potential rangeland plant community is a mid grass, post oak savannah. The composition, by weight, is about 75 percent grasses, 10 percent forbs, and 15 percent woody plants.

The predominant plants are sideoats grama, 15 percent; little bluestem, 10 percent; vine-mesquite, 10

percent; Texas needlegrass, 10 percent; and Arizona cottontop, hooded windmillgrass, silver bluestem, Canada wildrye, buffalograss, and sand dropseed, each 5 percent. Forbs, such as prairie-clover, Engelmann-daisy, and heath aster, make up 10 percent. Woody plants, such as post oak and skunkbush sumac, make up 10 percent and 5 percent, respectively.

Little bluestem, indiangrass, and Canada wildrye, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as sideoats grama, silver bluestem, Arizona cottontop, Texas needlegrass, hooded windmillgrass, skunkbush sumac, and post oak. If heavy grazing continues, the less preferred plants, with the exception of post oak and skunkbush sumac, also decline, and threeawn, low panicums, tumble lovegrass, other forbs, and mesquite invade. Post oak continues to increase, along with greenbrier, elm, mesquite, and skunkbush sumac.

This soil provides good habitat for deer and good nesting areas for doves, quail, turkeys, and songbirds. The hollow trees attract fur bearing animals.

The main limitations of this soil for most urban and recreation uses are low strength, moderate shrinking and swelling with changes in moisture content, and a clayey subsoil. These limitations can be overcome by proper design and careful installation.

This soil is in capability subclass IIIe and in the Tight Sandy Loam range site.

33—Pits. This map unit is made up of excavations where caliche or limestone has been removed. The caliche pits are mainly in areas of Cho and Mereta soils, and the limestone pits or quarries are mainly in areas of Lueders, Oplin, and Speck soils. The areas are scattered throughout the county and range from 5 acres to as much as 50 acres. The caliche and crushed limestone are used as fill and base material in road construction.

Most of these areas are not suitable for farming. Some of the abandoned Pits, however, have potential for limited grazing or as habitat for wildlife.

This map unit is not assigned to a capability subclass.

34—Rowden clay loam, 1 to 3 percent slopes. This moderately deep, gently sloping soil is on uplands, mainly along slightly convex ridges. Areas are irregular in shape and range from 10 to about 100 acres.

Typically, the surface layer is moderately alkaline, dark brown clay loam about 8 inches thick. The subsoil to a depth of 27 inches is moderately alkaline, reddish brown clay. The underlying material is indurated limestone that is coarsely fractured.

This soil is well drained. Runoff is medium. The permeability is slow, and the available water capacity is low. The rooting zone is moderately deep.

Included with this soil in mapping are small areas of Speck and Sagerton soils. Also included are areas of a soil that is similar to Rowden soil but has a thin surface layer and a few areas of nearly level Rowden soils. The included soils make up as much as 10 percent of a mapped area.

This soil can be cultivated, but it is used mainly for rangeland.

This Rowden soil is well suited to oats and grain sorghum. Crop residue left on the surface helps to prevent water erosion, conserve moisture, and improve tilth and water intake. Contour farming and terracing are needed in most areas to prevent water erosion. If cuts or excavations exceed 20 inches, there is a hazard of encountering the hard limestone.

This soil is moderately suited to pasture production. Improved grasses, such as kleingrass, coastal bermudagrass, weeping lovegrass, and King Ranch bluestem, grow on this soil.

Cattle prefer this soil to some of the adjoining soils because it is gently sloping and produces palatable forage. The potential rangeland plant community is a mid and tall grass, live oak prairie. The composition, by weight, is about 85 percent grasses, 10 percent forbs, and 5 percent woody plants.

The predominant plants are little bluestem, 15 percent; sideoats grama, 15 percent; Texas needlegrass, 10 percent; buffalograss, 10 percent; and indiangrass, Arizona cottontop, big bluestem, silver bluestem, Texas cupgrass, vine-mesquite, and meadow dropseed, each 5 percent. Forbs, such as Engelmann-daisy, trailing ratany, and wild vetch, make up 10 percent, and woody plants such as live oak make up 5 percent.

Little bluestem, big bluestem, indiangrass, and sideoats grama, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as buffalograss, silver bluestem, Texas needlegrass, dropseed, and live oak. If heavy grazing continues, the less preferred plants also decline, and threeawn, Texas grama, hairy tridens, other forbs, and mesquite invade. Mesquite continues to increase, along with pricklypear and tasajillo.

This soil provides fair habitat for deer and good nesting areas for doves, quail, and songbirds. The smooth terrain is less attractive to fur bearing animals than rough terrain. This soil has much greater value for grazing than as habitat for wildlife.

Limitations of this soil for most urban and recreation uses are depth to rock, low strength, and shrinking and swelling with changes in moisture content.

This soil is in capability subclass IIIe and in the Deep Redland range site.

35—Rowena clay loam, 0 to 1 percent slopes. This deep, calcareous soil is on nearly level plains and in valleys on uplands. Slopes are smooth, and surfaces are slightly concave to plane. Areas are oblong to irregular in shape and range from 10 to several hundred acres.

Typically, the surface layer is moderately alkaline, dark brown clay loam about 6 inches thick. The upper part of the subsoil between a depth of 6 to 24 inches is moderately alkaline, dark brown clay; the lower part

between a depth of 24 and 46 inches is moderately alkaline, reddish brown clay that is about 10 percent, by volume, calcium carbonate. The underlying layer between a depth of 46 and 60 inches is reddish yellow silty clay loam.

This soil is well drained. Runoff is slow. The permeability is moderately slow, and the available water capacity is high. Natural fertility and organic matter content are high.

Included with some areas of this soil in mapping are small areas of Abilene, Nuvalde, Nukrum, Leeray, and Sagerton soils. The included soils make up less than 20 percent of a mapped area.

This Rowena soil is used mainly for cropland or improved pasture. Small grain, forage sorghum, and cotton (fig. 16) are the main crops. A few areas are used for rangeland.

This soil is well suited to oats and wheat and moderately suited to grain sorghum, forage sorghum, and cotton. Residue from crops left on the surface helps to conserve moisture and maintain tilth and productivity.

This soil is moderately suited to pasture. Improved grasses, such as kleingrass, coastal bermudagrass, King Ranch bluestem, and weeping lovegrass, are suited to this soil.

This soil is favored for grazing because of the smooth topography and good forage production. The potential rangeland plant community is a short and mid grass prairie. The composition, by weight, is about 90 percent grasses, 10 percent forbs, and traces of woody plants.

The predominant plants are sideoats grama, 25 percent; vine-mesquite, 15 percent; silver bluestem, 10 percent; Arizona cottontop, 10 percent; buffalograss, 10 percent; Texas needlegrass, 10 percent; western wheatgrass, 5 percent; and white tridens, 5 percent. Forbs, such as Engelmann-daisy, heath aster, bundleflower, and catclaw sensitivebrier, make up 10 percent. There is a trace of such woody plants as elm and hackberry.

Sideoats grama, vine-mesquite, Arizona cottontop, and

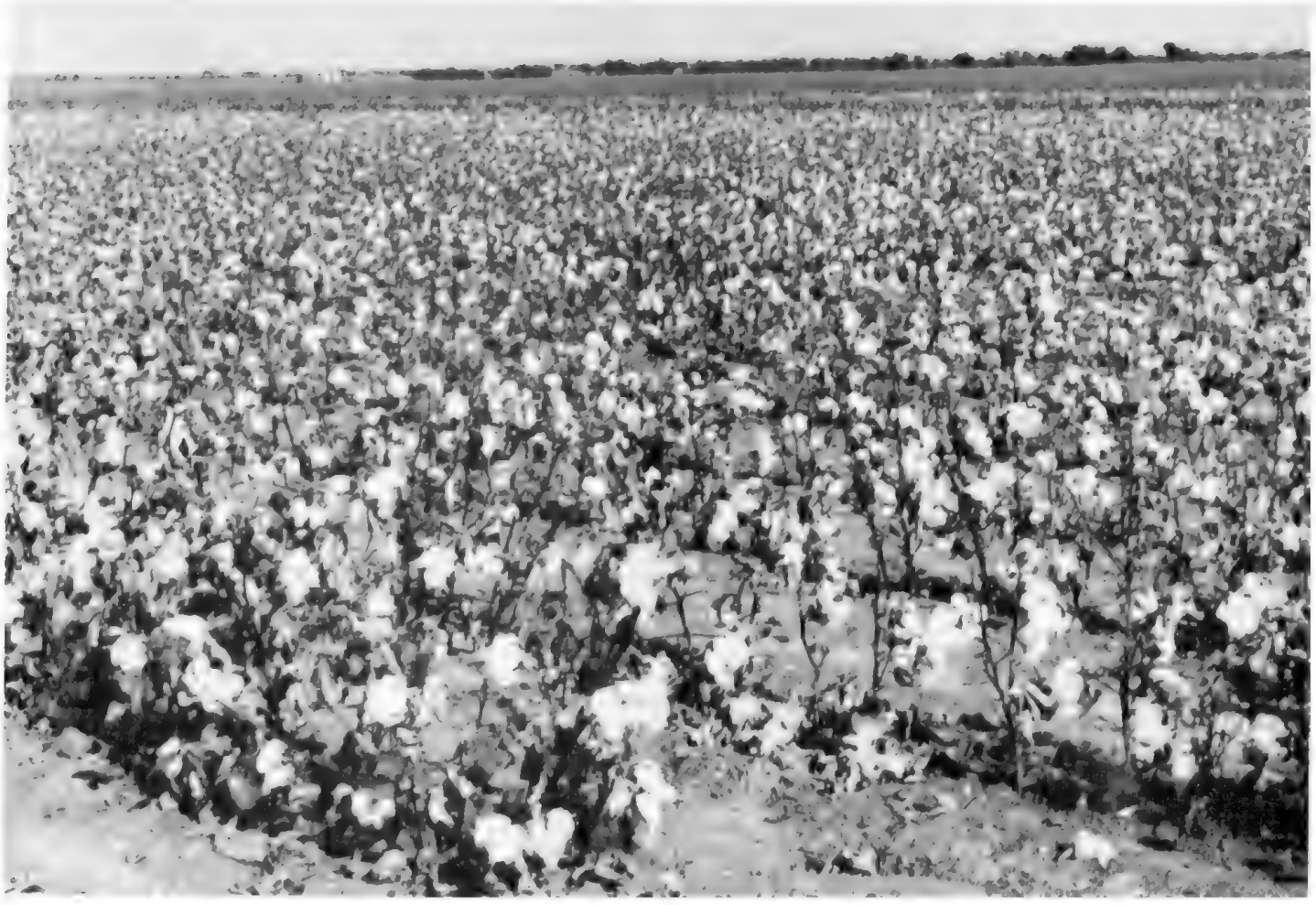


Figure 16.—Cotton on Rowena clay loam, 0 to 1 percent slopes.

western wheatgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, mainly buffalograss, silver bluestem, Texas needlegrass, and dropseed. If heavy grazing continues, the less preferred plants, with the exception of Texas needlegrass and buffalograss, also decline, and threeawn, hairy tridens, Texas grama, other forbs, mesquite, tasajillo, and pricklypear invade. Mesquite continues to increase, along with lotebush and pricklypear.

This soil provides fair nesting areas for doves, quail, and songbirds. It is limited as a habitat for wildlife because of the absence of woody plants.

This soil has limitations for most urban and recreation uses. Shrinking and swelling with changes in moisture content, low strength, and corrosivity to uncoated steel are the main limiting features. The clayey surface layer is a limitation for recreation uses.

This soil is in capability subclass IIc and in the Clay Loam range site.

36—Rowena clay loam, 1 to 3 percent slopes. This deep, gently sloping, calcareous soil is on plains and in valleys on uplands. Slopes are smooth and average less than 2 percent. Surfaces are slightly concave to plane. Areas are oblong to irregular in shape and range from 10 to 500 acres.

Typically, the surface layer is dark grayish brown clay loam about 10 inches thick. The subsoil extends to a depth of 39 inches and is dark grayish brown clay. The underlying layer between a depth of 39 and 60 inches is silty clay loam that has accumulations of calcium carbonate. Reaction is calcareous and moderately alkaline throughout.

This soil is well drained. Runoff is medium. The permeability is moderately slow, and the available water capacity is high. Natural fertility and organic matter content are high.

Included with some areas of this soil in mapping are areas of Abilene, Nukrum, Nuvalde, Leeray, and Sagerton soils. Also included are areas of Rowena soils that have slopes of 3 to 5 percent. The included soils make up less than 20 percent of a mapped area.

This Rowena soil is used mainly for cropland, rangeland, or improved pastureland. Small grain and forage sorghum are the main crops, but other crops are grown.

This soil is well suited to oats and moderately suited to wheat, grain sorghum, forage sorghum, and cotton. Contour farming and terracing are needed in most areas to prevent water erosion. Crop residue left on the surface helps to conserve moisture and maintain tilth and productivity.

This soil is moderately suited to pastureland. Introduced grasses, such as kleingrass, coastal bermudagrass, King Ranch bluestem, and weeping lovegrass, are suited to this soil.

This soil is favored for grazing because of the smooth topography and good forage production. The potential rangeland plant community is a short and mid grass prairie. The composition, by weight, is about 90 percent grasses, 10 percent forbs, and traces of woody plants.

The predominant plants are sideoats grama, 25 percent; vine-mesquite, 15 percent; silver bluestem, 10 percent; Arizona cottontop, 10 percent; buffalograss, 10 percent; Texas needlegrass, 10 percent; western wheatgrass, 5 percent; and white tridens, 5 percent. Forbs, such as Engelmann-daisy, heath aster, bundleflower, and catclaw sensitivebrier, make up 10 percent. There is a trace of such woody plants as elm and hackberry.

Sideoats grama, vine-mesquite, Arizona cottontop, and western wheatgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, mainly by buffalograss, silver bluestem, Texas needlegrass, and dropseed. If heavy grazing continues, the less preferred plants, with the exception of Texas needlegrass and buffalograss, also decline, and threeawn, hairy tridens, Texas grama, other forbs, mesquite, tasajillo, and pricklypear invade. Mesquite continues to increase, along with lotebush and pricklypear.

This soil provides fair nesting areas for doves, quail, and songbirds. It is limited as habitat for wildlife because of the absence of woody plants.

This soil has severe limitations for urban uses. Shrinking and swelling with changes in moisture content, low strength, and corrosivity to uncoated steel are the main limiting features. The moderately slow permeability is a limitation for most recreation uses.

This soil is in capability subclass IIe and in the Clay Loam range site.

37—Sagerton loam, 0 to 1 percent slopes. This deep, nearly level soil is on plains and in valleys on uplands. Slopes are smooth. Surfaces are mainly plane, but some are slightly concave. Areas are oblong to irregular in shape and range from 10 to more than 100 acres.

Typically, the surface layer is brown loam about 8 inches thick. The subsoil extends to a depth of 70 inches. It is dark brown and reddish brown clay between a depth of 8 and 27 inches and brown clay loam that has accumulations of calcium carbonate between a depth of 27 and 56 inches. The lower part of the subsoil between a depth of 56 and 70 inches is reddish yellow clay loam. Reaction is typically neutral in the upper part and moderately alkaline in the lower part.

This soil is well drained. Runoff is slow. The permeability is moderately slow, and the available water capacity is high. Natural fertility and organic matter content are medium.

Included with some areas of this soil in mapping are small areas of Abilene and Pedernales soils. Also included are areas of Sagerton clay loam. The included soils make up less than 20 percent of a mapped area.

This Sagerton soil is used mainly for cropland or improved pasture. Small areas are used for rangeland.

Small grain and forage sorghum are the main crops, but other crops are grown.

This soil is well suited to wheat, oats, grain sorghum, cotton, and forage sorghum. Residue from crops left on the surface helps to conserve moisture and maintain tilth and productivity.

This soil is well suited to pasture. Introduced grasses, such as kleingrass, improved bermudagrass, and weeping lovegrass, are commonly grown.

This soil is favored for grazing because of the smooth topography and good forage production. The potential rangeland plant community is a short and mid grass prairie. The composition, by weight, is about 90 percent grasses, 10 percent forbs, and traces of woody plants.

The predominant plants are sideoats grama, 25 percent; vine-mesquite, 15 percent; silver bluestem, 10 percent; Arizona cottontop, 10 percent; buffalograss, 10 percent; Texas needlegrass, 10 percent; western wheatgrass, 5 percent; and white tridens, 5 percent. Forbs, such as Engelmann-daisy, heath aster, bundleflower, and catclaw sensitivebrier, make up 10 percent. There is a trace of such woody plants as elm and hackberry.

Sideoats grama, vine-mesquite, Arizona cottontop, and western wheatgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, mainly buffalograss, silver bluestem, Texas needlegrass, and dropseed. If heavy grazing continues, the less preferred plants, with the exception of Texas needlegrass and buffalograss, also decline, and threeawn, hairy tridens, Texas grama, other forbs, mesquite, tasajillo, and pricklypear invade. Mesquite continues to increase, along with lotebush and pricklypear.

This soil provides fair nesting areas for doves, quail, and songbirds. It is limited as habitat for wildlife because of the absence of woody plants.

The main limitations of this soil for most urban and recreation uses are shrinking and swelling with changes in moisture content, low strength, and corrosivity to uncoated steel. The moderately slow permeability is a limitation for recreation areas.

This soil is in capability subclass IIc and in the Clay Loam range site.

38—Sagerton loam, 1 to 3 percent slopes. This deep, gently sloping soil is on plains and in valleys on uplands. Slopes are smooth and average about 2 percent. Surfaces are slightly concave to plane. Areas are oblong to irregular in shape and range from 10 to 200 acres.

Typically, the surface layer is dark brown loam about 7 inches thick. The subsoil is reddish brown clay to a depth of 25 inches, yellowish red clay to a depth of 40 inches, and reddish yellow clay loam to a depth of 65 inches (fig. 17). Reaction is typically mildly alkaline in the upper part and moderately alkaline in the lower part.

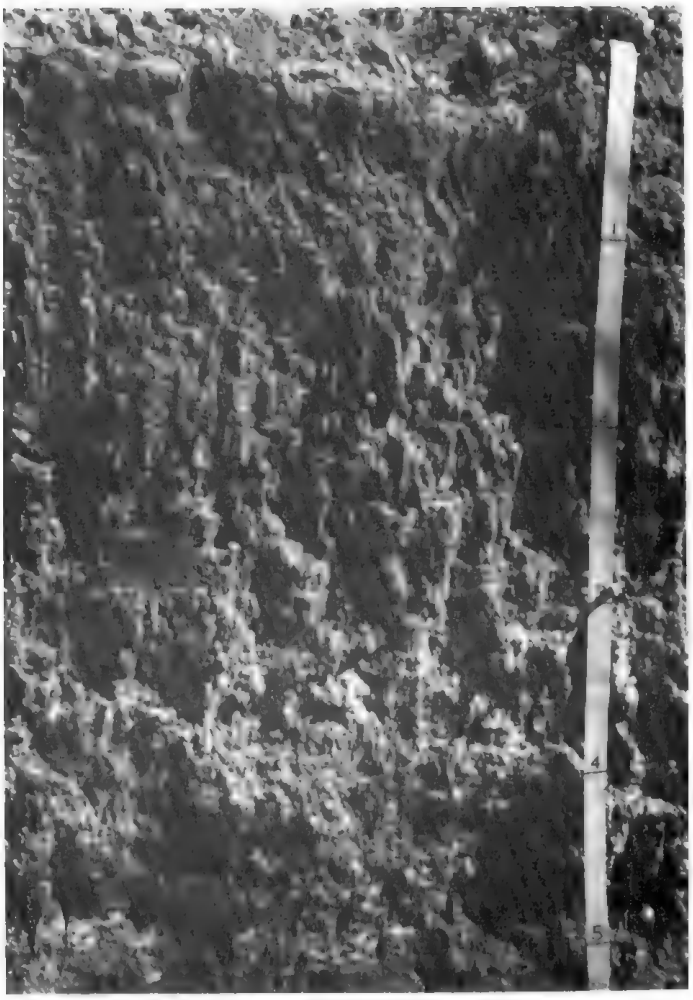


Figure 17.—Profile of Sagerton loam, 1 to 3 percent slopes.

This soil is well drained. Runoff is medium. The permeability is moderately slow, and the available water capacity is high. Natural fertility and organic matter content are moderate.

Included with this soil in mapping are areas of Abilene, Rowena, Callahan, and Pedernales soils. Also included are areas of Sagerton clay loam. The included soils make up less than 20 percent of a mapped area.

This Sagerton soil is used mainly for cropland, pastureland, or rangeland. Small grain and forage sorghum are the main crops, but other crops are grown.

This soil is well suited to oats and moderately suited to wheat, grain sorghum, forage sorghum, and cotton. Terracing and contour farming help to control water erosion. Crop residue left on the surface helps to conserve moisture and maintain tilth and productivity.

This soil is well suited to pasture. Introduced grasses, such as kleingrass, coastal bermudagrass, King Ranch bluestem, and weeping lovegrass, grow well on this soil.

This soil is favored for grazing because of the smooth topography and good forage production. The potential rangeland plant community is a short and mid grass prairie. The composition, by weight, is about 90 percent grasses, 10 percent forbs, and traces of woody plants.

The predominant plants are sideoats grama, 25 percent; vine-mesquite, 15 percent; silver bluestem, 10 percent; Arizona cottontop, 10 percent; buffalograss, 10 percent; Texas needlegrass, 10 percent; western wheatgrass, 5 percent; and white tridens, 5 percent. Forbs, such as Engelmann-daisy, heath aster, bundleflower, and catclaw sensitivebrier, make up 10 percent. There is a trace of such woody plants as elm and hackberry.

Sideoats grama, vine-mesquite, Arizona cottontop, and western wheatgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, mainly buffalograss, silver bluestem, Texas needlegrass, and dropseed. If heavy grazing continues, the less preferred plants, with the exception of Texas needlegrass and buffalograss, also decline, and threeawn, hairy tridens, Texas grama, other forbs, mesquite, tasajillo, and pricklypear invade. Mesquite continues to increase along with lotebush and pricklypear.

This soil provides fair nesting areas for doves, quail, and songbirds. It is limited as a habitat for wildlife because of the absence of woody plants.

The main limitations of this soil for most urban and recreation uses are shrinking and swelling with changes in moisture content, low strength, corrosivity to uncoated steel, and moderately slow permeability.

This soil is in capability subclass IIe and in the Clay Loam range site.

39—Speck clay loam, 1 to 3 percent slopes. This shallow, gently sloping soil is on uplands, mainly along slightly convex limestone ridges. Slopes are smooth and average about 2 percent. Areas are irregularly shaped and range from 10 to 150 acres.

Typically, the surface layer is slightly acid, brown clay loam about 7 inches thick. The subsoil is moderately alkaline, reddish brown clay that extends to a depth of 18 inches. The underlying material is strongly cemented, fractured limestone.

This soil is well drained. Runoff is medium. The permeability is slow, and the available water capacity is very low. The root zone is shallow.

Included with this soil in mapping are small areas of Rowden soils and small areas of a soil that is similar to the Speck soils but is underlain by weakly cemented caliche. The included soils make up less than 20 percent of a mapped area.

This Speck soil can be cultivated, but it is used mainly as rangeland.

This soil is moderately suited to oats and wheat and poorly suited to grain sorghum. Crop residue left on the surface helps to prevent water erosion, conserve moisture, and improve tilth and water intake.

This soil is moderately suited to pasture. Improved grasses, such as kleingrass, coastal bermudagrass, weeping lovegrass, and King Ranch bluestem, are suited to the soil.

This soil has high value for livestock production. The potential rangeland plant community is a mid grass, live oak prairie. The composition, by weight, is about 85 percent grasses, 5 percent forbs, and 10 percent woody plants.

The predominant plants are little bluestem, 20 percent; sideoats grama, 15 percent; Texas cupgrass, 10 percent; tall dropseed, 10 percent; and indiangrass, big bluestem, silver bluestem, Texas needlegrass, buffalograss, and Canada wildrye, each 5 percent. Forbs, such as prairie-clover, Engelmann-daisy, and bushsunflower, make up 5 percent. Woody plants such as live oak make up 5 percent of the composition, and hackberry and bumelia make up 5 percent.

Little bluestem, sideoats grama, and Texas cupgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as tall dropseed, silver bluestem, buffalograss, catclaw, and prickly ash. If heavy grazing continues, the less preferred plants, with the exception of catclaw and prickly ash, also decline, and threeawn, Texas grama, other forbs, and mesquite invade. Prickly ash continues to increase, along with mesquite, tasajillo, pricklypear, and catclaw.

This soil provides good habitat for deer and good nesting areas for doves, quail, turkeys, and songbirds.

The main limitation of this soil for urban and recreation uses is the limited depth to bedrock.

This soil is in capability subclass IIIe and in the Redland range site.

40—Speck-Throck association, gently undulating. This association is on stony uplands, mainly on plateaus and ridges. Slopes are dominantly 1 to 5 percent. Areas are irregular in shape and range from 20 to several hundred acres. Gravel-, cobble-, and stone-sized fragments are scattered over the surface in sufficient quantities to preclude most farming operations.

Speck soil makes up about 60 percent of the association; Throck and similar soils, about 20 percent; and other soils, about 20 percent. The areas of this map unit are large, and the composition is variable. However, the detail is adequate for the forseeable uses of the soils.

The Speck soil is on plateaus and broad ridges. Typically, the surface layer is neutral, dark brown, stony clay loam about 6 inches thick. The subsoil between a depth of 6 and 18 inches is moderately alkaline, dark reddish brown clay that has a few limestone cobbles. The underlying material is a thick bed of hard limestone that has reddish brown clay in the crevices (fig. 18).

Speck soil is well drained. Runoff is medium. The permeability is slow, and the available water capacity is very low.

Figure 18.—Profile of Speck stony clay loam in an area of Speck-Throck association, gently undulating.

The Throck soil is mainly below small knolls and on the more sloping areas of the map unit. The surface layer is moderately alkaline, brown, stony clay loam about 7 inches thick. The subsoil between a depth of 7 and 29 inches is moderately alkaline, light yellowish brown clay. The underlying layer is light gray and light yellowish brown shaly clay.

Throck soil is well drained. Runoff is medium. The permeability is slow, and the available water capacity is medium.

Included with this association in mapping are areas of Cho, Lueders, Nukrum, Rowden, and Nuvalde soils. Also included are a few areas of nearly level Speck and Throck soils. The included soils average about 20 percent of each mapped area.

These Speck-Throck soils are poorly suited to cropland and pastureland. They are generally too stony for cultivation. The few areas of arable soils are so small and irregularly shaped that cultivation is impractical. A few small areas are planted to pasture grasses, such as kleingrass. Most areas of this association are used for rangeland.

This soil has high value for livestock production. The potential rangeland plant community on the Speck soil is a mid grass, live oak prairie. The composition, by weight, is about 85 percent grasses, 5 percent forbs, and 10 percent woody plants.

The predominant plants are little bluestem, 20 percent; sideoats grama, 15 percent; Texas cupgrass, 10 percent; tall dropseed, 10 percent; and indiangrass, big bluestem, silver bluestem, Texas needlegrass, buffalograss, and Canada wildrye, each 5 percent. Forbs, such as prairie-clover, Engelmann-daisy, and bushsunflower, make up 5 percent. Woody plants such as live oak make up 5 percent of the composition, and hackberry and bumelia make up 5 percent.

Little bluestem, sideoats grama, and Texas cupgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as tall dropseed, silver bluestem, buffalograss, catclaw, and prickly ash. If heavy grazing continues, the less preferred plants, with the exception of catclaw and prickly ash, also decline, and threeawn, Texas grama, other forbs, and mesquite invade. Prickly ash continues to increase, along with mesquite, tasajillo, pricklypear, and catclaw.

The potential rangeland plant community on the Throck soil is a mid and short grass prairie with an occasional woody plant. The composition, by weight, is about 85 percent grasses, 10 percent forbs, and 5 percent woody plants.

The predominant plants are sideoats grama, 20 percent; buffalograss, 15 percent; Arizona cottontop, 10 percent; vine-mesquite, 10 percent; Texas needlegrass, 10 percent; and silver bluestem, western wheatgrass, hairy dropseed, and Texas cupgrass, each 5 percent. Forbs, such as prairie-clover, dotted gayfeather, and catclaw sensitivebrier, make up 10 percent; and woody plants, such as hackberry and live oak, make up 5 percent.

Sideoats grama, Arizona cottontop, and Texas cupgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as buffalograss, silver bluestem, dropseed, Texas needlegrass, and lotebush. If heavy grazing continues, the less preferred plants, with the exception of lotebush, also decline, and threeawn, Texas grama, hairy tridens, other forbs, and mesquite invade. Lotebush continues to increase, along with tasajillo, mesquite, and pricklypear.

These soils provide fair habitat for deer and good nesting areas for doves, quail, turkeys, and songbirds. The undulating terrain is somewhat attractive to fur bearing animals.

The main limitations of these soils for most urban and recreation uses are the limited depth to limestone bedrock, stony surface layers, and corrosivity to uncoated steel.

The soils in this association are in capability subclass VIs. The Speck soil is in the Redland range site, and the Throck soil is in the Shallow Clay range site.

41—Throck clay loam, 2 to 5 percent slopes. This moderately deep, gently sloping, calcareous soil is on

uplands, mainly on convex ridges and the upper part of the side slopes. Areas are elongated to irregular in shape and range from 10 to more than 100 acres.

Typically, the surface layer is moderately alkaline, dark grayish brown clay loam about 6 inches thick. The subsoil between a depth of 6 and 34 inches is moderately alkaline, light yellowish brown silty clay loam that grades to silty clay in the lower part. The underlying material between a depth of 34 and 40 inches is light gray, shaly clay.

This soil is well drained. Runoff is medium. The permeability is slow, and the available water capacity is medium. The root zone is moderately deep. The hazard of water erosion is moderate.

Included with some areas of this soil in mapping are small areas of Nukrum soils on the lower part of the slopes, and areas of Callahan, Rowden, Owens, and Speck soils on the upper part of the slopes. Also included are areas of a soil that has a dark surface layer more than 10 inches thick. The included soils make up less than 20 percent of a mapped area.

This Throck soil can be cultivated, but it is used mainly as rangeland.

This soil is moderately suited to wheat, oats, and grain sorghum. Crop residue left on the surface helps to prevent water erosion, conserve moisture, and improve tilth and water intake. Contour farming and terracing are needed in most areas to prevent water erosion.

This soil is moderately suited to pastureland. Introduced grasses, such as kleingrass, King Ranch bluestem, Caucasian bluestem, Old World bluestem, and improved bermudagrass, are suited to this soil.

The potential rangeland plant community is a mid and short grass prairie with an occasional woody plant. The composition, by weight, is about 85 percent grasses, 10 percent forbs, and 5 percent woody plants.

The predominant plants are sideoats grama, 20 percent; buffalograss, 15 percent; Arizona cottontop, 10 percent; vine-mesquite, 10 percent; Texas needlegrass, 10 percent; and silver bluestem, western wheatgrass, hairy dropseed, and Texas cupgrass, each 5 percent. Forbs, such as prairie-clover, dotted gayfeather, and catclaw sensitivebrier, make up 10 percent, and woody plants, such as hackberry and live oak, make up 5 percent.

Sideoats grama, Arizona cottontop, and Texas cupgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as buffalograss, silver bluestem, dropseed, Texas needlegrass, and lotebush. If heavy grazing continues, the less preferred plants, with the exception of lotebush, also decline, and threeawn, Texas grama, hairy tridens, other forbs, and mesquite invade. Lotebush continues to increase, along with tasajillo, mesquite, and pricklypear.

This soil provides fair habitat for deer and good nesting areas for doves, quail, and songbirds.

The main limitations of this soil for most urban and recreation uses are shrinking and swelling with changes in moisture content, low strength, corrosivity to uncoated steel, and a clayey surface layer.

This soil is in capability subclass IVe and in the Shallow Clay range site.

42—Throck-Callahan-Owens association, undulating. This association is on uplands. Slopes range from 1 to 8 percent but average about 6 percent. Areas are irregular in shape and range from 50 to several hundred acres.

The Throck soils make up about 45 percent of the association; Callahan soils, about 25 percent; Owens soils, about 10 percent; and other soils, about 20 percent. The Throck soils are on the mid and upper slopes of hillsides, the gently sloping Callahan soils are on side slopes and foot slopes, and the sloping Owens soils are on eroded side slopes. Areas of this map unit are large, and the composition is variable. However, the detail is adequate for the foreseeable uses of the soils.

The Throck soil typically has a surface layer of moderately alkaline, brown clay loam about 6 inches thick. The subsoil between a depth of 6 and 28 inches is moderately alkaline, brownish clay. The underlying material is light gray, shaly clay. Mapped with these soils are areas of a similar soil that has a grayish subsoil and areas of a soil that has a dark surface layer.

Throck soils are well drained. Runoff is medium to rapid. The permeability is slow, and the available water capacity is medium.

The Callahan soil typically has a surface layer of mildly alkaline, brown clay loam about 6 inches thick. The upper part of the subsoil between a depth of 5 and 13 inches is mildly alkaline, reddish brown clay. The lower part between a depth of 13 and 35 inches is moderately alkaline clay that is brown in the upper part and light gray in the lower part. The underlying material is light yellowish brown, shaly clay.

Callahan soil is well drained. Runoff is medium. The permeability is very slow, and the available water capacity is low.

The Owens soil typically has a surface layer of moderately alkaline, light yellowish brown clay about 4 inches thick. The subsoil between a depth of 4 and 18 inches is moderately alkaline, light yellowish brown clay. The underlying material is light gray, shaly clay.

Owens soil is well drained. Runoff is rapid. The permeability is very slow, and the available water capacity is very low.

Included with these soils in mapping are areas of Chaney, Frio, Leeray, Nukrum, and Pedernales soils. Chaney and Pedernales soils are on side slopes and foot slopes. Leeray and Nukrum soils are on lower lying slopes. Frio soils are on flood plains. Also included, in places, are small areas of stony soils. The included soils make up an average of about 20 percent of each map unit.

The soils in this Throck-Callahan-Owens association are generally too sloping for cultivation. They are better

suited to rangeland. Some areas of these soils are arable, but they are too small and irregular in shape to be cultivated.

These soils are moderately suited to pasture. Some areas are planted to King Ranch bluestem and kleingrass.

The potential rangeland plant community on the Throck and Owens soils is a mid and short grass prairie. The composition, by weight, is about 85 percent grasses, 10 percent forbs, and 5 percent woody plants.

Predominant plants are sideoats grama, 20 percent; buffalograss, 15 percent; Arizona cottontop, 10 percent; vine-mesquite, 10 percent; Texas needlegrass, 10 percent; and silver bluestem, western wheatgrass, hairy dropseed, and Texas cupgrass, each 5 percent. Forbs, such as prairie-clover, dotted gayfeather, and catclaw sensitivebrier, make up 10 percent, and woody plants, such as hackberry and live oak, make up 5 percent.

Sideoats grama, Arizona cottontop, and Texas cupgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as buffalograss, silver bluestem, dropseed, Texas needlegrass, and lotebush. If heavy grazing continues, the less preferred plants, with the exception of lotebush, also decline, and threeawn, Texas grama, hairy tridens, other forbs, and mesquite invade. Lotebush continues to increase, along with tasajillo, mesquite, and pricklypear.

The potential rangeland plant community on the Callahan soil is a mid and short grass prairie. The composition, by weight, is about 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

The predominant plants are sideoats grama, 15 percent; silver bluestem, 15 percent; Texas needlegrass, 15 percent; Arizona cottontop, 10 percent; white tridens, 10 percent; buffalograss, 10 percent; vine-mesquite, 10 percent; and other perennial grasses, 5 percent. Forbs, such as heath aster, bundleflower, and Engelmann-daisy, make up 5 percent, and woody plants, such as hackberry and lotebush, make up 5 percent.

Sideoats grama, Arizona cottontop, and vine-mesquite, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, mainly buffalograss, silver bluestem, Texas needlegrass, and lotebush. If heavy grazing continues, the less preferred plants also decline, and threeawn, Texas grama, red grama, other forbs, tasajillo, pricklypear, and mesquite invade. Mesquite continues to increase, along with lotebush, pricklypear, and tasajillo.

These soils provide fair nesting places for doves, quail, and songbirds. Some deer frequent areas of the Throck and Owens soils. The undulating terrain attracts fur bearing animals.

These soils are limited for most urban and recreation uses because of slope, corrosivity to uncoated steel, low strength, and shrinking and swelling with changes in moisture content.

The soils in this association are in capability subclass VIe. The Throck soil and the Owens soil are in the Shallow Clay range site, and the Callahan soil is in the Claypan Prairie range site.

43—Throck-Owens-Lueders association, hilly. This association is on stony uplands. Slopes range from 5 to more than 30 percent but average about 15 percent. Areas are long and narrow to irregular in shape and range from 20 acres to several hundred acres.

The Throck soil makes up about 50 percent of the association; Owens soil, about 20 percent; Lueders soil, about 15 percent; and other soils, about 15 percent. The Throck soil is on convex hillslopes, the Owens soil is on eroded hillslopes, and the Lueders soil is on convex ridges and along escarpments. The areas of this map unit are large, and the composition is variable. However, the detail is adequate for the foreseeable uses of the soils.

The Throck soil typically has a surface layer of moderately alkaline, brown, stony clay loam about 5 inches thick. The subsoil between a depth of 5 and 31 inches is moderately alkaline, brownish clay loam. The underlying material to a depth of 40 inches is massive, light yellowish brown silty clay.

Throck soil is well drained. Runoff is rapid. The permeability is slow, and the available water capacity is medium.

The Owens soil typically has a surface layer of moderately alkaline, light brownish gray, stony clay about 4 inches thick. The subsoil is moderately alkaline, light brownish gray clay to a depth of 17 inches. The underlying material is light brownish gray, shaly clay.

Owens soil is well drained. Runoff is rapid. The permeability is very slow, and the available water capacity is low. The root zone is shallow.

The Lueders soil typically has a surface layer of moderately alkaline, dark grayish brown, very cobbly clay loam to a depth of 13 inches. This layer is about 50 percent, by volume, of cobbles, stones, and gravel-size fragments of limestone. The surface layer rests abruptly on a thick layer of strongly cemented, fractured limestone.

Lueders soil is well drained. Runoff is rapid. The permeability is moderate, and the available water capacity is very low. The root zone is shallow.

Included with this association in mapping are areas of Speck soils, which occur mainly on ridgetops, and areas of Leeray and Nukrum soils. Also included are soils that are similar to the Lueders soil but are moderately deep over limestone, soils that have a clayey surface layer, and in some areas soils that are similar to the Throck soil but that have a thick dark surface layer. Outcrops of rock also occur in this map unit. The included soils average about 15 percent of a mapped area.

These Throck-Owens-Lueders soils are not suitable for cultivation because of slope, stones, and susceptibility to water erosion. They are used mainly for range and as wildlife habitat.

The potential rangeland plant community on the Throck and Owens soils is a mid and tall grass prairie. The composition, by weight, is about 85 percent grasses, 10 percent forbs, and 5 percent woody plants.

The predominant plants are little bluestem, 15 percent; sideoats grama, 15 percent; Texas cupgrass, 10 percent; hairy dropseed, 10 percent; and indiangrass, Canada wildrye, cane bluestem, Texas needlegrass, buffalograss, rough tridens, and big bluestem, each 5 percent. Forbs, such as Engelmann-daisy, bundleflower, dotted gayfeather, and heath aster, make up 10 percent; and woody plants, such as hackberry, elm, and elbowbush, make up 5 percent.

Little bluestem, indiangrass, big bluestem, and Canada wildrye, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as sideoats grama, cane bluestem, dropseed, Texas needlegrass, and elbowbush. If heavy grazing continues, the less preferred plants, with the exception of elbowbush, also decline, and threeawn, hairy tridens, red grama, other forbs, and mesquite invade. Mesquite continues to increase, along with lotebush, tasajillo, pricklypear, and skunkbush sumac.

The potential plant community on the Lueders soil is a mid and short grass prairie with scattered live oak. The composition, by weight, is 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

The predominant plants are sideoats grama, 30 percent; slim and rough tridens, 15 percent; buffalograss and curly mesquite, 15 percent; hairy dropseed, 10 percent; Texas needlegrass, 10 percent; silver bluestem, 5 percent; and little bluestem, 5 percent. Forbs, such as prairie-clover, dotted gayfeather, and Engelmann-daisy, make up 5 percent, and woody plants such as live oak make up 5 percent.

Little bluestem, sideoats grama, and slim tridens, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as Texas needlegrass, silver bluestem, buffalograss, curly mesquite, and dropseed. If heavy grazing continues, the less preferred plants also decline, and threeawn, hairy tridens, fall witchgrass, red grama, and pricklypear invade.

These soils provide fair nesting areas for quail and songbirds. Deer inhabit areas of the Throck and Owens soils. Fur bearing animals are attracted to this area.

The main limitations of these soils for most urban or recreation uses are slope, shrinking and swelling with changes in moisture content, and stony surface layers.

The soils in this association are in capability subclass VIIs. The Throck soil and the Owens soil are in the Rocky Hills range site, and the Lueders soil is in the Very Shallow range site.

44—Throck-Speck association, undulating. This association is on uplands. Slopes range from 1 to 8 percent but average about 6 percent. Areas are irregular in shape and range from 20 to several hundred acres. Fragments of limestone gravel, cobble, and stone are scattered on the surface in sufficient quantities to prevent normal tillage.

The Throck soil makes up about 60 percent of the association; Speck soil, about 20 percent; and other soils, about 20 percent. The areas of this map unit are large, and the composition is variable. However, the detail is adequate for the foreseeable uses of the soils.

The Throck soil is on mid slopes and the upper part of the slopes below the ridgetops. Typically, the surface layer is moderately alkaline, grayish brown, stony clay loam about 6 inches thick. The subsoil extends to a depth of 30 inches. The upper part is moderately alkaline, brown silty clay loam that grades to yellowish brown silty clay loam in the lower part. The underlying layer is moderately alkaline, light yellowish brown shaly silty clay.

Throck soil is well drained. Runoff is rapid. The permeability is slow, and the available water capacity is medium.

The Speck soil is on the lower part of the slopes. Typically, the surface layer is mildly alkaline, dark grayish brown, stony clay loam about 5 inches thick. The subsoil, between a depth of 5 and 15 inches is moderately alkaline, brown clay. This layer rests abruptly on light brownish gray limestone.

Speck soil is well drained. Runoff is medium to rapid. The permeability is slow, and the available water capacity is very low.

Included with this association in mapping are small areas of Lueders, Mereta, Nukrum, Owens, and Rowena soils. Also included are areas of soils that are similar to the Throck soils but have a dark surface layer more than 10 inches thick. The included soils make up about 20 percent of each mapped area.

These Throck-Speck soils are generally too sloping or too stony for cultivation. The areas of arable soils are so small and irregular in shape that cultivation is impractical. The soils are moderately suited to pastureland. A few areas are planted to pasture grasses, such as King Ranch bluestem and kleingrass. These soils are best suited to rangeland.

The potential rangeland plant community on the Throck soil is a mid and short grass prairie with an occasional woody plant. The composition, by weight, is about 85 percent grasses, 10 percent forbs, and 5 percent woody plants.

The predominant plants are sideoats grama, 20 percent; buffalograss, 15 percent; Arizona cottontop, 10 percent; vine-mesquite, 10 percent; Texas needlegrass, 10 percent; and silver bluestem, western wheatgrass, hairy dropseed, and Texas cupgrass, each 5 percent. Forbs, such as prairie-clover, dotted gayfeather, and catclaw sensitivebrier, make up 10 percent, and woody plants, such as hackberry and live oak, make up 5 percent.

Sideoats grama, Arizona cottontop, and Texas cupgrass, which are preferred plants, are grazed out first

by heavy grazing. These plants are replaced by less preferred plants, such as buffalograss, silver bluestem, dropseed, Texas needlegrass, and lotebush. If heavy grazing continues, the less preferred plants, with the exception of lotebush, also decline, and threeawn, Texas grama, hairy tridens, other forbs, and mesquite invade. Lotebush continues to increase, along with tasajillo, mesquite, and pricklypear.

The Speck soil has high value for livestock production. The potential plant community is a mid grass, live oak prairie. The composition, by weight, is about 85 percent grasses, 5 percent forbs, and 10 percent woody plants.

The predominant plants are little bluestem, 20 percent; sideoats grama, 15 percent; Texas cupgrass, 10 percent; tall dropseed, 10 percent; and indiangrass, big bluestem, silver bluestem, Texas needlegrass, buffalograss, and Canada wildrye, each 5 percent. Forbs, such as prairie-clover, Engelmann-daisy, and bushsunflower, make up 5 percent. Woody plants such as live oak make up 5 percent of the composition, and hackberry and bumelia make up 5 percent.

Little bluestem, sideoats grama, and Texas cupgrass, which are preferred plants, are grazed out first by heavy grazing. These plants are replaced by less preferred plants, such as tall dropseed, silver bluestem, buffalograss, catclaw, and prickly ash. If heavy grazing continues, the less preferred plants, with the exception of catclaw and prickly ash, also decline, and threeawn, Texas grama, other forbs, and mesquite invade. Prickly ash continues to increase, along with mesquite, tasajillo, pricklypear, and catclaw.

These soils provide good habitat for deer and good nesting areas for doves, quail, turkeys, and songbirds. They are not very attractive to fur bearing animals.

The main limitations of these soils for most urban and recreation uses are the slope, corrosivity to uncoated steel, low strength, shrinking and swelling with changes in moisture content, and stony surface layers.

The soils in this association are in capability subclass VIs. The Throck soil is in the Shallow Clay range site, and the Speck soil is in the Redland range site.

prime farmland soils

This section provides information about prime farmland soils in Callahan County. It defines and discusses requirements and lists the prime farmland soils.

Each year, thousands of acres of land throughout the United States are converted from agricultural to industrial, urban, and other soil uses. Some of this land includes prime farmland.

Prime farmland soils are one of several kinds of important farmland soils defined by the U.S. Department of Agriculture. They are of major importance in providing the Nation's short- and long-range needs for food and fiber. The supply of high quality farmland is limited. The U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, must encourage and facilitate the use of our Nation's prime farmland soils with wisdom and foresight.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to producing food, feed, forage, fiber, and oilseed crops. These soils have the quality, growing season, and moisture supply needed to economically produce a sustained high yield of crops if treated and managed using acceptable farming methods. Prime farmland soils produce the highest yields with minimal inputs of energy and economic resources, and farming results in the least damage to the environment.

Prime farmland soils include those currently being used for crops, pasture, rangeland, or other purposes, with the exception of urban and built-up land or water areas. The soils must either be used for producing food or fiber or be available for these uses.

Prime farmland soils generally have an adequate and dependable supply of moisture from precipitation or irrigation. They also have a favorable temperature and growing season and an acceptable level of acidity or alkalinity. These soils have few or no rocks and are permeable to water and air. Prime farmland soils are not excessively erosive or saturated with water for long periods and are not flooded during the growing season. Slope ranges mainly from 0 to 5 percent. For more detailed information regarding the criteria for prime farmland soils, consult the local staff of the Soil Conservation Service.

About 139,940 acres or nearly 26 percent of the soils in Callahan County meets the requirements for prime farmland soils. Areas of these soils are scattered throughout the county, but the Leeray-Sagerton-Nukrum, Pedernales-Cisco-Hext, and Frio-Gageby general soil map units have the largest areas of prime farmland soils. The Throck-Speck-Lueders and the Chaney-Demona map units also have substantial areas, but the Oplin-Hext-Brackett map unit has only small scattered areas. Approximately 95,000 acres of the prime farmland soils is used for cultivated crops. These crops are mainly wheat, oats, grain sorghum, and peanuts.

A recent trend in land use in some parts of the county has resulted in the loss of some areas of prime farmland soils to urban and industrial uses. This loss puts demands on marginal lands, which generally are more erosive, droughty, difficult to cultivate, and less productive.

The detailed map units of prime farmland soils in Callahan County are listed in this section. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in Table 4. The location is shown on the detailed soil maps at the back of this survey. The soil qualities that affect use and management are described in the section "Detailed soil map units."

Soils that have limitations such as a high water table, are subject to flooding, or receive inadequate rainfall, may qualify as prime farmland soils if these limitations can be overcome by corrective measures, such as drainage, flood control, or irrigation. Onsite evaluation is necessary to determine whether the corrective measures have been effective.

The map units listed below meet the requirements for prime farmland, unless the soils are urban or built-up land, or they do not have a developed irrigation water supply that is dependable and of adequate quality. Certain areas of map units 7, 9, 14, and 34 do not have an adequate irrigation water supply.

Urban or built-up land is any contiguous unit of land 10 acres or more that is used for residences, industrial sites, commercial sites, construction sites, institutional sites, public administration sites, railroad yards, small parks, cemeteries, airports, golf courses, sanitary landfills, sewage treatment plants, water control structures and spillways, or shooting ranges.

1—Abilene loam, 0 to 1 percent slopes
2—Abilene loam, 1 to 3 percent slopes
7—Chaney loamy fine sand, 1 to 3 percent slopes
9—Chaney Variant loamy fine sand, 0 to 1 percent slopes
11—Cisco loamy fine sand, 1 to 3 percent slopes

12—Cisco fine sandy loam, 1 to 3 percent slopes
14—Cisco-Hext-Pedernales complex, 1 to 5 percent slopes
17—Frio clay loam, occasionally flooded
19—Gageby loam, occasionally flooded
21—Leeray clay, 0 to 1 percent slopes
22—Leeray clay, 1 to 3 percent slopes
25—Nukrum clay, 1 to 3 percent slopes
26—Nukrum clay, 3 to 5 percent slopes
27—Nuvalde clay loam, 1 to 3 percent slopes
30—Pedernales loamy fine sand, 1 to 3 percent slopes
31—Pedernales fine sandy loam, 1 to 3 percent slopes
34—Rowden clay loam, 1 to 3 percent slopes
35—Rowena clay loam, 0 to 1 percent slopes
36—Rowena clay loam, 1 to 3 percent slopes
37—Sagerton loam, 0 to 1 percent slopes
38—Sagerton loam, 1 to 3 percent slopes

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops and pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

In 1967, more than 111,097 acres was used for crops and pasture in Callahan County (*4*). Of this total, 405 acres was used for permanent pasture; 13,983 acres for row crops; 46,837 acres for close-grown crops, mainly wheat and oats; 1,622 acres for orchards; and the rest was idle cropland or land in grasses, legumes, or small grain for conservation purposes.

The potential of the soils in this county for increased production of food is good. Several thousand acres of potentially good cropland is currently used for rangeland and pastureland. In addition to the reserve production capacity represented by this land, food production could also be increased considerably by extending the latest crop production technology to all cropland in the county. This soil survey can greatly facilitate the application of such technology.

Soil erosion is the major soil problem on nearly all of the cropland that has slope of more than 2 percent. Water erosion is a hazard on the Callahan, Cisco, Nukrum, Pedernales, and Throck soils, for example, which have slopes of as much as 5 percent.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a clayey subsoil, such as the Callahan, Chaney, Pedernales, and Throck soils, and on soils that have a layer of bedrock that limits the depth of the root zone. Shallow and moderately deep soils that are underlain by bedrock include the Bonti, Speck, and Rowden soils. Erosion also reduces productivity on soils, such as Callahan loam, that tend to be droughty. Second, soil erosion on farmland results in sediment entering streams. Controlling erosion minimizes the pollution of streams by sediment and improves the quality of water for muncipal use, for recreation, and for fish and wildlife.

Erosion control practices provide protective surface cover, reduce runoff, and increase infiltration. A cropping system that keeps a vegetative cover on the surface for extended periods can hold soil losses to amounts that do not reduce the productive capacity of the soils.

Management of residue is an effective practice. A sufficient amount of crop residue left on the surface

protects the soil against compaction caused by rains, reduces crusting, decreases runoff, and reduces evaporation of soil moisture. The residue shades the soil and thus reduces soil temperatures. In addition, it adds organic matter to the soil, improves the tilth of the surface soil, and reduces compaction caused by farm machinery. Crop residue should be protected from grazing and burning. Tillage equipment that keeps residue on the surface should be used.

Minimum tillage for grain sorghum is effective in reducing erosion on sloping land. This practice, which is commonly and increasingly used, can be adapted to most soils in the survey area.

Terraces farmed on the contour reduce the length of slope and help to control runoff and erosion. They are most practical on deep and moderately deep, clayey and loamy soils that have slopes of more than 1 percent.

Soil blowing is a hazard on the sandy Cisco, Chaney, Patilo, and Demona soils. It can damage these soils in a few hours if winds are strong and the soils are dry and bare of vegetation or surface mulch. Stripcropping, vegetative cover, or surface mulch minimize this hazard. Most crops provide adequate cover during the growing season but do not leave enough residue to protect and improve the soil. Such crops as peanuts need to be followed by a cover crop, such as rye and vetch.

Information regarding the design of erosion control practices for each kind of soil is contained in the Technical Guide, available in local offices of the Soil Conservation Service.

Soil fertility is low to medium in most soils on uplands in the survey area. Nitrogen and phosphorus are the most deficient minerals, but a few sandy soils are deficient in potash. The soils on flood plains, such as Gageby and Frio soils, are naturally higher in plant nutrients than most upland soils.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils that have good tilth are granular and porous.

Many of the soils used for crops have a surface layer of fine sandy loam or loam that is light in color and low in organic matter content. Generally, the structure of such soils is weak, and intense rainfall causes the formation of a crust on the surface. Once the crust forms, it reduces infiltration and increases runoff. Regular additions of crop residue, manure, and other organic material can help to improve soil structure and reduce crust formation.

The dark Nukrum and Leeray soils are clayey, and tilth is a concern because the soils often stay wet until late in spring. If they are plowed when wet, these soils tend to be very cloddy when dry and good seedbeds are difficult to prepare. Fall plowing generally results in good tilth in spring.

Field crops suited to the soils and climate of the survey area include some that are not now commonly grown. Grain sorghum and peanuts are the principal row crops. Cotton, corn, guar, soybeans, castor beans, sunflowers, and similar crops can be grown if economic conditions are favorable.

Wheat, oats, and forage sorghum are the common close-grown crops. Rye, barley, vetch, alfalfa, and millet are also grown. Grass seed can be produced from kleingrass, King Ranch bluestem, and weeping lovegrass.

Special crops grown commercially in the survey area are vegetables, small fruits, tree fruits, and nursery plants. A small acreage throughout the county is used for watermelons, cantaloupes, sweet potatoes, sweet corn, tomatoes, peppers, and other vegetables and small fruits. Other areas are adapted to other special crops, such as blackberries, grapes, and many vegetables. Pecans, peaches, and apples are the most important tree fruits grown in the county.

Deep soils that have good natural drainage and that warm up early in spring are especially well suited to many vegetables and small fruits. In the survey area, Cisco, Chaney, Pedernales, and Sagerton soils are deep and have slopes of less than 3 percent. Timely irrigation may double the yields of horticultural crops in most years. Sprinkler irrigation works satisfactorily on gently sloping soils and is generally the only type suitable for most sandy soils. Soils in low positions where frost is frequent and air drainage is poor, however, are generally poorly suited to early vegetables, small fruits, and orchards.

Latest information and suggestions for special crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Pastureland is important in Callahan County because raising livestock is the main farm enterprise. For the past several years, the trend has been to convert land from other uses to pasture and hay. Land used for pasture and hay is generally planted to introduced grasses that respond to good management. These grasses in combination with native range are mainly used to provide year-round grazing. Among the important grasses are coastal bermudagrass, kleingrass-75, weeping lovegrass, johnsongrass, indiangrass, switchgrass, King Ranch bluestem, and caucasian bluestem.

Improved bermudagrass, such as coastal bermudagrass and kleingrass-75, are best suited to deep soils on bottom lands, such as Gageby and Frio soils. These two grasses, however, are adapted to most of the soils in the county in which a good seedbed can be prepared. Weeping lovegrass is widely suited and provides good yields of forage on moderately coarse and coarse textured upland soils, such as Bonti, Chaney, Cisco, Patilo, and Demona soils. King Ranch bluestem and caucasian bluestem, two drought-tolerant grasses, are well suited to such soils as Callahan loam, Mereta clay loam, Speck clay loam, and Throck clay loam.

Good management practices for pasture include fertilization, rotational grazing to maintain proper grazing heights of forage, weed and brush control, and maintaining an adequate water supply. Good

management practices for hay include fertilization and cutting forage at the correct height and at the proper stage of growth.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in the section "Detailed soil map units."

rangeland

John A Wright, range conservationist, Soil Conservation Service, assisted in writing this section.

About 76 percent of Callahan County, or 418,457 acres, is native rangeland. More than 75 percent of the agricultural income is derived from the raising of livestock. The main source of forage for livestock is

range grasses and forbs. Income from wildlife and recreational enterprises on rangeland is becoming increasingly important.

Most ranchers are managing cow-calf operations, although stocker steers or heifers make up a significant percentage of some herds. Several ranchers specialize in breeding and selling purebred and crossbred cattle.

On many ranches, forage produced on rangeland is supplemented by tame pasture, crop stubble, and small grain. In winter the native forage is generally supplemented with protein concentrate. Creep feeding of calves and yearlings to increase market weight is practiced on some ranches.

The native vegetation in many parts of the survey area has been greatly depleted by continued excessive use. Much of the acreage that was once open grassland is now covered with mesquite brush, weeds, and cactus. In these areas, the amount of forage produced may be less than half of that originally produced.

There are three distinct types of rangeland in the county. The most extensive tracts are in areas underlain by limestone mixed with shale, where most of the soils are hilly, shallow, and loamy or clayey. These dominantly limestone areas produce mid and tall grasses interspersed with a variety of forbs and shrubs and live oak trees. The potential productivity is low to medium.

Scattered throughout the county are tracts of rangeland that are mostly open grassland prairie. The soils are deep and loamy or clayey. They formed in sediment of the valleys and outwash plains. The soils support mid grasses, and potential productivity is medium to high. Mesquite is now growing on most areas where brush management has not been practiced.

In areas around the communities of Cross Plains, Clyde, and Denton Valley, the rangeland is mostly an oak savannah commonly called "West Cross Timbers" The soils in these areas are loamy or sandy and support post oak trees and tall and mid grasses. The potential productivity is medium to high.

The major management concern on most of the rangeland is controlling grazing so that the kinds and amounts of plants that make up the potential plant community can be reestablished. This goal can be attained by proper stocking and using a deferred grazing system. Controlling brush is also important and can be done mechanically, chemically, or biologically. Seeding adapted grasses, such as little bluestem, sideoats grama, indiangrass, kleingrass, and King Ranch bluestem, prevents excessive runoff and erosion and furnishes desirable forage in areas of inadequate vegetation.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 7 shows, for each soil, the range site and the total annual production of vegetation in favorable, average, and unfavorable years. Explanation of the column headings in table 7 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an average year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air-dry moisture.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of plants, reducing undesirable brush species, conserving water, and controlling erosion water and soil blowing. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

windbreaks and environmental plantings

Ed Holcombe, forester, Soil Conservation Service, assisted in writing this section.

Woody plants serve several purposes in Callahan County. Trees and shrubs reduce wind erosion on

cropland and are used for farmstead protection. They screen dwellings for privacy and reduce noise pollution. These plants provide livestock and feedlot protection, and they are used by wildlife for food and cover. Esthetics is also a consideration. Woody plants can be used to beautify areas.

Field windbreaks are narrow plantings of one to five rows made at right angles to the prevailing winds and at specific intervals across the field. They protect crops from high winds, reduce soil blowing, and help to retain moisture in the soil. Wildlife use these plantings for food, cover, and as travelways.

Farmstead and feedlot windbreaks are designed to protect homes and other buildings and livestock from harsh winds both in winter and summer. Windbreaks have a definite effect on fuel savings. Woody plants are also used for noise abatement. Plantings made close to busy highways can reduce road noises.

Environmental plantings help to beautify and screen houses and other buildings. Evergreen trees and shrubs give year-long environmental protection and provide color to the landscape during winter.

To insure survival, healthy planting stock should be used, plantings should be made on a well prepared site, and the plants should be maintained in good condition. Water is essential to good survival during the first 2 or 3 years after establishment. Proper maintenance, including root plowing of field windbreaks, can increase the quality of all plantings.

Woody plants are essential to the needs of many kinds of wildlife. Trees and shrubs provide food and cover to game birds, songbirds, and animals. The amount of wildlife almost always increases where trees and shrubs are planted. Species of woody plants should be selected that provide food and cover for wildlife as well as the other purposes for which they are planted.

Additional information regarding the use of woody plants, including planning, sources of supply, and planting and care can be obtained from the local offices of the Soil Conservation Service or the Cooperative Extension Service.

recreation

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

wildlife habitat

John A. Wright, range conservationist, Soil Conservation Service, assisted in preparing this section.

Antelope, buffalo, lesser prairie chickens, and prairie dogs were once abundant in Callahan County. Deer,

turkeys, raccoons, ringtail cats, rabbits, and squirrels were plentiful along the wooded streams. Antelope, prairie chickens, and buffalo were destroyed as the county was settled, and none are known to exist now. Overgrazing and intensive cultivation have reduced the habitat for deer, turkeys, quail, and squirrels.

Deer, turkeys, and squirrels inhabit areas throughout the county, but they tend to concentrate along the creeks and water courses because food and cover are available. Doves and quail are plentiful where food, water, and nesting cover are available. Fur bearers include foxes, badger, bobcat, raccoons, skunks, and oppossums. Coyotes, rabbits, armadillo, and small mammals are numerous.

During migration, ducks and geese use the flood prevention lakes and farm ponds in the county and Pecan Bayou. A variety of fish also inhabit these water areas.

Most rangeland has a secondary land use as wildlife habitat. Some areas are inhabited exclusively by wildlife. Leasing these areas to sportsmen for hunting and fishing privileges is widespread. It provides additional income for landowners and recreation for sportsmen.

Conservation practices can be designed to benefit wildlife. Proper use and deferment of grazing on rangeland provide additional food, cover, and nesting areas. Properly designed management programs increase the border area between the woodland and the rangeland and improve food supplies while retaining adequate cover. Pastures established to seed producing grasses or forbs benefit game birds. Leaving crop residue on the surface and retaining brushy fence rows provide food and cover on cropland.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are grain sorghum, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are johnsongrass, lovegrass, kleingrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, vine-mesquite grass, wheatgrass, and sunflower.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are skunkbush sumac, greenbrier, plum, hackberry, and oak.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland

plants are smartweed, switchgrass, willows, cattails, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, dove, meadowlark, field sparrow, cottontail, and red fox.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, shore birds, and frogs.

Habitat for rangeland wildlife consists of areas of grassland, trees, and wild herbaceous plants. Wildlife attracted to rangeland include turkey, white-tail deer, coyotes, jackrabbits, meadowlark, and bobwhite quail.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to

bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

sanitary facilities

Table 11 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive

or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across

a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 17.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 17.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

physical and chemical properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.
5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.
6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.
7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.
8. Stony or gravelly soils and other soils not subject to wind erosion.

soil and water features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Cemented pans are cemented or indurated subsurface layers within a depth of 5 feet. Such pans cause difficulty in excavation. Pans are classified as thin or thick. A thin pan is less than 3 inches thick if continuously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A thick pan is more than 3 inches thick if continuously indurated or more than 18 inches thick if discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

engineering index test data

Table 17 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil series and their morphology." The soil samples were tested by Texas State Department of Highways and Public Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); Specific gravity, (Particle index) T 100 (AASHTO), D 653 (ASTM); Shrinkage—T 92 (AASHTO), D 427 (ASTM).

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*6*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 18, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning dry, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Calciustolls (*Calci*, meaning calcareous, plus *ustolls*, the suborder of the Mollisols that have a dry moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Calciustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, thermic Typic Calciustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*5*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*6*). Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Abilene series

The Abilene series consists of deep, well drained loamy soils on uplands. These soils are on broad flats and in shallow valleys. The soils formed in ancient alluvium. Slope ranges from 0 to 3 percent.

Typical pedon of Abilene loam, 0 to 1 percent slopes, from the junction of Texas Highway 36 and Farm Road 3146 at the town of Rowden, this pedon is about 0.8 mile north on county road, and 40 feet east of road right-of-way in cropland:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak fine subangular blocky and fine granular structure; hard,

friable; many fine roots; few very fine siliceous pebbles; moderately alkaline; abrupt smooth boundary.

B21t—9 to 21 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, firm; common fine roots; thin clay films on faces of peds; few very fine white siliceous pebbles; moderately alkaline; gradual smooth boundary.

B22t—21 to 32 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 4/2) moist; moderate medium blocky structure; very hard, firm; common fine roots; thin clay films on faces of peds; few very fine concretions and films of calcium carbonate in lower part; calcareous; moderately alkaline; gradual wavy boundary.

B23tca—32 to 53 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; hard, firm; few fine roots in upper part; common fine pores; many concretions and soft bodies of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

Cca—53 to 80 inches; pink (7.5YR 8/4) clay loam, pink (7.5YR 7/4) moist; massive; hard, firm; common very fine pores; many concretions and white powdery bodies of calcium carbonate.

The solum ranges from 35 to 60 inches in thickness. Soft powdery forms of calcium carbonate are at a depth of 28 inches. Depth to a calcic horizon ranges from 28 to 60 inches.

The A horizon is dark brown, brown, dark grayish brown, or grayish brown. Reaction ranges from neutral to moderately alkaline.

The B21t and B22t horizons are brown, dark brown, grayish brown, or dark grayish brown. Texture is clay loam, clay, or silty clay loam. Reaction ranges from neutral to moderately alkaline. Coarse fragments range from none to about 5 percent, by volume, and mainly consist of fine, rounded siliceous pebbles and calcium carbonate concretions.

The B23tca and Cca horizons are brown, pale brown, light brown, brownish yellow, very pale brown, reddish yellow, or pink. They are sandy clay loam, clay loam, silty clay loam, or clay.

Bonti series

The Bonti series consists of moderately deep, well drained, loamy soils on uplands. These soils formed in interbedded sandstone and clays. Slope ranges from 1 to 8 percent.

Typical pedon of Bonti fine sandy loam, 1 to 3 percent slopes; from the intersection of Farm Road 880 and Farm Road 1864 about 5 miles south of the town of Putnam, this pedon is about 2,500 feet south on Farm Road 880, 258 feet west on an unimproved road, and 3 feet north of the road in wooded pastureland:

A1—0 to 4 inches; brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; slightly hard, friable; many roots; common worm casts; few fine siliceous pebbles; neutral; clear smooth boundary.

A2—4 to 8 inches; brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable; common roots; common worm casts; few fine siliceous pebbles; neutral; clear smooth boundary.

B21t—8 to 16 inches; reddish brown (2.5YR 4/4) sandy clay, reddish brown (2.5YR 4/4) moist; moderate fine blocky structure; very hard, firm; common roots; few fine pores; few worm casts; continuous clay films on surfaces of peds; few fine siliceous pebbles; medium acid; gradual smooth boundary.

B22t—16 to 30 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; common fine distinct strong brown (7.5YR 5/6) mottles; moderate fine blocky structure; very hard, firm; continuous clay films on ped surfaces; common weakly cemented, gravel-size sandstone fragments in the lower part; medium acid; abrupt smooth boundary.

R—30 to 35 inches; strong brown and gray sandstone, weakly cemented in the upper 2 inches, strongly cemented below.

Thickness of the solum and depth to sandstone range from 20 to 40 inches. Content of sandstone fragments in the A horizon ranges from none to about 15 percent, by volume. The fragments range from 1/2 inch to 20 inches in diameter.

The A1 horizon is brown, yellowish brown, or grayish brown. The A2 horizon, if present, is 1 or 2 units of value lighter than the A1 horizon. The A horizon is slightly acid or neutral.

The B2t horizon is red, yellowish red, reddish brown, or light reddish brown. The lower part of the B2t horizon commonly has a few dark red, reddish yellow, strong brown, or yellowish brown mottles. Coarse fragments in the Bt horizon range from none to 15 percent, by volume, and are mainly less than 3 inches in diameter. The B2t horizon is clay loam, sandy clay, or clay. Clay content ranges from 35 to 45 percent.

The underlying sandstone is strongly cemented and interbedded with clay.

Brackett series

The Brackett series consists of shallow, well drained soils on uplands. These soils formed in calcareous, silty shales. Slope ranges from 8 to 30 percent.

Typical pedon of Brackett gravelly loam, in an area of Hext-Oplin-Brackett association, hilly; from the intersection of Texas Highway 206 and Texas Highway 36 in the town of Cross Plains, this pedon is about 4 miles north on Texas Highway 206 to an intersection with a county road, 1.5 miles west, north, and west on

county road, 3.1 miles north, and 24 feet west in rangeland:

A1—0 to 4 inches; pale brown (10YR 6/3) gravelly loam, brown (10YR 5/3) moist; moderate fine and very fine subangular blocky and granular structure; hard, friable; many fine roots; many worm casts; surface covered with limestone gravel and fossil shell fragments; estimated 30 percent, by volume, limestone gravel and shell fragments; about 55 percent calcium carbonate equivalent; calcareous; moderately alkaline; clear wavy boundary.

B2—4 to 13 inches; light gray (10YR 7/2) gravelly loam, brown (10YR 5/3) moist; moderate fine and very fine subangular blocky structure; hard, friable; common fine roots; many worm casts; about 10 percent, by volume, limestone gravel and fossil shell fragments; common thin platy shale fragments; about 60 percent calcium carbonate equivalent; calcareous; moderately alkaline; clear wavy boundary.

Cr—13 to 20 inches; white (10YR 8/2) silty shale, light gray (10YR 7/2) moist; few fine roots between plates in upper part; calcareous; moderately alkaline.

The solum ranges from 10 to 20 inches in thickness. Content of coarse fragments ranges from a few pieces of gravel-size limestone to 35 percent, by volume, platy, weakly to strongly cemented limestone fragments as much as 5 inches in diameter. The soil, including the Cr horizon, is 40 to more than 80 percent calcium carbonate, excluding fragments coarser than 20 millimeters.

The A horizon is brown, grayish brown, light yellowish brown, light brownish gray, or pale brown.

The B horizon is light gray, grayish brown, brown, yellowish brown, light brownish gray, pale brown, light yellowish brown, or very pale brown. It is loam, gravelly loam, clay loam, or gravelly clay loam. The noncarbonate clay content ranges from 10 to 30 percent.

The Cr horizon is light brownish gray, very pale brown, or white. The Cr horizon is chalk and calcareous, silty shales that have bedding planes and shale fragments.

Callahan series

The Callahan series consists of moderately deep, well drained soils on uplands. These soils formed in material weathered from interbedded shaly clay. Slope ranges from 1 to 8 percent.

Tyical pedon of Callahan loam, 1 to 3 percent slopes; from the intersection of Farm Road 880 and Farm Road 1864, which is 5 miles south of the town of Putnam, this pedon is about 500 feet east on Farm Road 1864, and 200 feet south of highway right-of-way in a cultivated field:

Ap—0 to 4 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; hard, friable; common fine roots; moderately alkaline; abrupt smooth boundary.

B2t—4 to 20 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; ped faces slightly darker; moderate medium blocky structure; very hard, very firm; few fine roots; continuous clay films on ped surfaces; moderately alkaline; gradual smooth boundary.

B2tca—20 to 34 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; common fine faint brown (7.5YR 5/4) mottles; moderate medium blocky structure; very hard, very firm; few fine roots; clay films on ped surfaces; common fine concretions and soft bodies of calcium carbonate; few fine siliceous pebbles; calcareous; moderately alkaline; gradual smooth boundary.

B3ca—34 to 38 inches; brown (7.5YR 5/4) clay, brown (7.5YR 5/4) moist; few fine faint brown and gray mottles; weak medium blocky structure; very hard, very firm; few clay films on ped surfaces; common fine concretions and soft bodies of calcium carbonate; few fine siliceous pebbles; calcareous; moderately alkaline; gradual smooth boundary.

Cr—38 to 45 inches; light brownish gray (2.5Y 6/2) shaly clay, grayish brown (2.5Y 5/2) moist; about 10 percent is reddish yellow (7.5YR 6/6); massive; extremely hard, very firm; common fine concretions and soft bodies of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 24 to 40 inches in thickness. Depth to layers containing secondary calcium carbonate ranges from 18 to 28 inches. Coarse fragments of siliceous pebbles, sandstone fragments, and concretions range from a few to about 10 percent, by volume. Reaction ranges from neutral to moderately alkaline in the A horizon and upper part of the B2t horizon and from mildly alkaline to moderately alkaline in the lower part of the solum.

The A horizon is reddish brown or brown. The Bt horizon is reddish brown, dark reddish brown, yellowish red, or brown. It is clay or clay loam. Clay content ranges from 35 to 50 percent.

The Cr horizon of shale is commonly interbedded with thin strata of sandstone and loamy or clayey sediment.

Chaney series

The Chaney series consists of deep, moderately well drained soils on uplands. These soils have a sandy surface layer and a clayey subsoil. They formed in loamy and clayey materials. Slope ranges from 0 to 8 percent.

Typical pedon of Chaney loamy fine sand, 1 to 3 percent slopes; from the intersection of Farm Road 604 and Texas Highway 36 at the town of Denton, this pedon is about 2.2 miles east on Texas Highway 36 to an intersection with a county road, 0.4 mile north on county road, and 500 feet west of county road south of pipeline right-of-way in wooded rangeland:

A1—0 to 4 inches; brown (10YR 5/3) loamy fine sand, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable; common very fine roots; neutral; clear smooth boundary.
A2—4 to 14 inches; pink (7.5YR 7/4) loamy fine sand, brown (7.5YR 5/4) moist; single grained; loose; common very fine and fine roots; neutral; abrupt smooth boundary.
B21t—14 to 23 inches; light yellowish brown (10YR 6/4) sandy clay, yellowish brown (10YR 5/4) moist; common prominent medium and fine red (2.5YR 5/6) mottles; moderate fine and medium blocky structure; very hard, very firm; few very fine and fine roots; few very fine and fine pores; clay films on faces of peds; neutral; clear smooth boundary.
B22t—23 to 45 inches; light yellowish brown (10YR 6/4) sandy clay, yellowish brown (10YR 5/4) moist; many coarse to very fine distinct reddish yellow (7.5YR 6/6) mottles; many light gray (10YR 6/2) films and mottles on ped faces; moderate coarse prismatic structure; very hard, firm; clay films on ped surfaces; neutral; clear wavy boundary.
B3—45 to 60 inches; light gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; many medium to very fine brownish yellow (10YR 6/6) and strong brown (7.5YR 5/6) mottles; moderate coarse prismatic structure; very hard, firm; few fine dark concretions (Fe and Mn oxides) in upper part; few soft masses of soft calcium carbonate; moderately alkaline; clear wavy boundary.
C—60 to 72 inches; light gray (10YR 7/1) sandy clay loam, gray (10YR 6/1) moist; few fine distinct yellowish brown mottles; massive; hard, friable; moderately alkaline.

The solum ranges from 30 to 60 inches in thickness.

The A horizon is loamy fine sand or stony sandy loam. Coarse fragments of siliceous pebbles and conglomerate sandstone fragments range from 0 to 35 percent, by volume. Reaction is neutral or slightly acid. The A1 horizon is light brown, brown, grayish brown, dark grayish brown, yellowish brown, light yellowish brown, or pale brown. The A2 horizon is 1 to 3 units of value lighter than the A1 horizon. The A1 and A2 horizons are usually mixed during cultivation.

The Bt horizon is reddish brown, red, dark red, yellowish red, reddish yellow, light brown, light yellowish brown, light brownish gray, yellowish brown, or brownish yellow and has few to many mottles in shades of gray, red, yellow, and brown. It is sandy clay or clay. Clay content ranges from 35 to 50 percent. The lower part of the Bt horizon may be sandy clay loam. Reaction ranges from medium acid to neutral.

The B3 horizon, if present, is mottled brownish yellow, strong brown, red, pale brown, light gray, or gray. It is sandy clay loam or sandy clay.

The C horizon ranges from sandy loam to shaly clay. Some pedons have thin, weakly cemented, discontinuous sandstone layers. Reaction ranges from moderately alkaline to neutral. Most pedons have a few films, threads, or soft bodies of calcium carbonate in the C horizon.

Chaney Variant

Chaney Variant consists of deep, somewhat poorly drained soils on uplands. These soils are on the bottoms of enclosed depressions or intermittent lakes. They have a sandy surface layer and a clayey subsoil. Slope ranges from 0 to 1 percent.

Typical pedon of Chaney Variant loamy fine sand, 0 to 1 percent slopes; from the intersection of Farm Road 2700 and Farm Road 604 south of the town of Clyde, this pedon is 0.5 mile north on Farm Road 604 toward Clyde, and 98 feet north of highway right-of-way in bermudagrass pastureland:

A1—0 to 7 inches; light brownish gray (10YR 6/2) loamy fine sand, grayish brown (10YR 5/2) moist; weak fine granular structure; slightly hard, very friable; many fine roots; mildly alkaline; clear smooth boundary.
A2—7 to 18 inches; very pale brown (10YR 8/3) loamy fine sand, very pale brown (10YR 7/3) moist; common fine distinct light brown (7.5YR 6/4) mottles; few fine faint gray mottles; single grained; soft, very friable; many fine roots; mildly alkaline; abrupt smooth boundary.
B21t—18 to 28 inches; gray (10YR 6/1) sandy clay, gray (10YR 5/1) moist; common fine prominent yellowish red (5YR 4/6) mottles; moderate medium and coarse blocky structure; extremely hard, very firm; common fine roots; mildly alkaline; gradual wavy boundary.
B22t—28 to 50 inches; gray (10YR 6/1) sandy clay, gray (10YR 5/1) moist; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium and coarse blocky structure; extremely hard, very firm; few fine roots; slightly acid; gradual wavy boundary.
B3—50 to 65 inches; gray (10YR 6/1) sandy clay, gray (10YR 6/1) moist; common fine distinct yellowish brown (10YR 5/6) mottles; moderate coarse blocky structure; very hard, firm; few fine roots; few fine concretions of calcium carbonate; moderately alkaline.

The A1 horizon is brown, grayish brown, dark grayish brown, yellowish brown, pale brown, or light brownish gray. Reaction is neutral or slightly acid. The A2 horizon is 1 to 3 units of value lighter than the A1 horizon. The A1 and A2 horizons are usually mixed during cultivation.

The Bt horizon is gray or light gray. It has many mottles of red, yellow, and brown throughout. Texture is sandy clay. Clay content ranges from 35 to 50 percent. The lower part of the Bt horizon is sandy clay loam in some pedons. Reaction ranges from medium acid to neutral.

The B3 horizon, if present, is mottled brownish yellow, strong brown, red, pale brown, light gray, or gray. It is sandy clay loam or sandy clay.

Cho series

The Cho series consists of very shallow and shallow, well drained, loamy soils on uplands. These soils formed in calcareous, old alluvium over hard caliche. Slope ranges from 1 to 5 percent.

Typical pedon of Cho gravelly loam, 1 to 5 percent slopes; from the intersection of U.S. Highway 283 and Texas Highway 36, which is 12 miles south of the town of Baird, this pedon is 575 feet north on U.S. Highway 283 to a gate, 450 feet east on a private road, and 160 feet north in rangeland:

A1—0 to 10 inches; brown (10YR 4/3) gravelly loam, dark brown (10YR 3/3) moist; weak fine and very fine subangular blocky structure; hard, friable; many fine roots; 18 percent gravel-size caliche fragments; about 50 percent calcium carbonate equivalent; calcareous; moderately alkaline; abrupt wavy boundary.

C1cam—10 to 15 inches; pinkish white (7.5YR 8/2), strongly cemented caliche; laminar in upper part; clear wavy boundary.

C2ca—15 to 50 inches; pink (7.5YR 8/4) caliche of gravelly loam texture, pink (7.5YR 7/4) moist; massive; hard, friable; estimated 30 percent, by volume, caliche, limestone, chert, and siliceous pebbles; calcareous; moderately alkaline.

Depth to the strongly cemented C1cam horizon ranges from 7 to 20 inches.

The A horizon is brown, dark brown, grayish brown, dark grayish brown, or very dark grayish brown. Calcium carbonate equivalent in the soil fraction less than 20 millimeters is 40 to about 65 percent. Pebbles of caliche and quartz make up 5 to 30 percent, by volume. Cobbles of caliche make up none to about 5 percent, by volume.

The C1cam horizon is platy or massive and laminar in the upper part. The C2ca horizon ranges from pinkish white to very pale brown but is mainly pink. It is loam, gravelly loam, or clay loam and is 40 to 80 percent calcium carbonate equivalent. Siliceous and limestone pebbles make up 2 to about 35 percent, by volume. Thickness ranges from a few to several feet.

Cisco series

The Cisco series consists of deep, well drained, loamy and sandy soils on uplands. These soils formed in loamy material. Slope ranges from 1 to 8 percent.

Typical pedon of Cisco fine sandy loam, 1 to 3 percent slopes; from the intersection of Farm Road 880 and Texas Highway 206 in the northern part of the town of Cross Plains, this pedon is about 2.5 miles north on Farm Road 880 to intersection with a county road, 0.7 mile west, and 576 feet south of road in a cultivated field:

Ap—0 to 9 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; hard, friable; common fine roots; few fine siliceous pebbles; slightly acid; abrupt smooth boundary.

B21t—9 to 23 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate fine and medium subangular blocky structure; hard, firm; common fine roots; common fine pores; thin clay films; few fine siliceous pebbles; slightly acid; gradual smooth boundary.

B22t—23 to 42 inches; yellowish red (5YR 4/8) sandy clay loam, yellowish red (5YR 4/8) moist; moderate medium subangular blocky structure; hard, friable; few fine roots; common fine pores; few fine siliceous pebbles; thin clay films; slightly acid; gradual wavy boundary.

B3—42 to 49 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 5/6) moist; moderate coarse subangular blocky structure; hard, friable; few fine roots; common fine pores; few fine siliceous pebbles; few threads and films and a few very fine soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

Cca—49 to 65 inches; pink (7.5YR 8/4) sandy clay loam, pink (7.5YR 7/4) moist; massive; hard, friable; common concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 40 to 70 inches in thickness. Within a depth of 60 inches, there is more than a 20 percent reduction in clay content from the maximum. Secondary carbonates are at a depth of 36 to 60 inches in some pedons. Some pedons have a few siliceous pebbles.

The A1 or Ap horizon is brown, reddish brown, grayish brown, pale brown, or yellowish brown. It is fine sandy loam or loamy fine sand. Some pedons have an A2 horizon that is 1 or 2 units of value lighter than the A1 horizon. The A horizon is slightly acid or neutral.

The B2t horizon is reddish brown, yellowish red, or red. It is sandy clay loam or clay loam. Clay content ranges from about 20 to 35 percent. Reaction is slightly acid or neutral. Weatherable mineral content is less than 10 percent.

The B3 horizon is reddish brown, yellowish red, reddish yellow, or brown. Yellowish brown, brown, and red mottles range from few to many or may be absent in some pedons. This horizon is sandy clay loam or fine sandy loam. Reaction ranges from slightly acid to mildly alkaline.

The C horizon is sandy clay loam, loam, or fine sandy loam. In some pedons there is weakly cemented

packsand or sandstone that becomes friable upon moistening. Reaction is mildly alkaline or moderately alkaline.

Demona series

The Demona series consists of deep, moderately well drained, sandy soils on uplands. These soils have a thick sandy surface layer and a clayey subsoil. Slope ranges from 1 to 5 percent.

Typical pedon of Demona fine sand, in an area of Demona-Patilo complex, 1 to 5 percent slopes; from the town of Cottonwood, this pedon is 3.2 miles south on a county road to an intersection with another county road, 0.2 mile west on county road, and 105 feet north in cropland:

Ap—0 to 8 inches; light brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) moist; single grained; loose; common fine roots; few fine siliceous pebbles; slightly acid; abrupt smooth boundary.

A2—8 to 25 inches; very pale brown (10YR 7/4) fine sand, light yellowish brown (10YR 6/4) moist; single grained; loose; few fine roots; few fine siliceous pebbles; neutral; clear smooth boundary.

B21t—25 to 36 inches; light yellowish brown (10YR 6/4) sandy clay, light yellowish brown (10YR 6/4) moist; many fine prominent red (2.5YR 4/6) and common fine distinct yellowish red (5YR 5/6) and light brownish gray (10YR 6/2) mottles; moderate medium blocky structure; very hard, very firm; few fine roots; common thin clay films on faces of peds; common fine siliceous pebbles; slightly acid; gradual wavy boundary.

B22t—36 to 44 inches; mottled light gray (10YR 6/1) and red (2.5YR 5/8) sandy clay, gray (10YR 5/1) and red (2.5YR 4/8) moist; few medium distinct yellowish brown (10YR 5/6) mottles; weak medium blocky structure; very hard, firm; common thin clay films on faces of peds; about 10 percent, by volume, siliceous pebbles; slightly acid; gradual wavy boundary.

B23t—44 to 52 inches; mottled light gray (10YR 6/1) and brownish yellow (10YR 6/6) sandy clay, light gray (10YR 6/1) and brownish yellow (10YR 6/6) moist; common fine distinct yellowish red (5YR 5/6) mottles; weak medium subangular blocky structure; very hard, very firm; common thin clay films on faces of peds; common fine siliceous pebbles; neutral; clear wavy boundary.

B3—52 to 61 inches; light gray (10YR 7/1) sandy clay, light gray (10YR 7/1) moist; common medium distinct red (2.5YR 5/8) mottles; ped faces are light brown (7.5YR 6/4); weak medium blocky structure; very hard, very firm; few fine and medium bodies of calcium carbonate; noncalcareous matrix; moderately alkaline; gradual wavy boundary.

C—61 to 70 inches; mottled white (10YR 8/1) and reddish yellow (5YR 6/8) sandy clay loam, light gray (10YR 7/1) and yellowish red (5YR 5/8) moist; massive; hard, friable; noncalcareous; moderately alkaline.

The solum ranges from 50 to 80 inches in thickness.

The A1 horizon is light brown, brown, grayish brown, dark grayish brown, or very pale brown. Reaction ranges from slightly acid to mildly alkaline. The A2 horizon is pale brown, very pale brown, or light brown. Reaction ranges from medium acid to neutral.

The B2t and B3 horizons are red, light gray, light yellowish brown, or brownish yellow with varied amounts of red, yellow, brown, and gray mottles. Texture is dominantly sandy clay and ranges to clay. Clay content ranges from 35 to 45 percent. Reaction of the B2t horizon ranges from medium acid to neutral. The B3 horizon is sandy clay or sandy clay loam, and reaction ranges from slightly acid to moderately alkaline.

The C horizon ranges from sandy clay loam to sandy clay.

These Demona soils are taxadjuncts to the Demona series because they are typically neutral in the lower part of the Bt horizon and moderately alkaline in the B3 and C horizons. These differences, however, do not affect use, management, and behavior.

Exray series

The Exray series consists of shallow, well drained, loamy soils on uplands. These soils formed over sandstone. Slope ranges from 1 to 8 percent.

Typical pedon of Exray stony fine sandy loam, in an area of Bonti-Callahan-Exray complex, 1 to 8 percent slopes; from the intersection of Texas Highway 6 and Farm Road 880 in the northeastern part of Callahan County, 0.8 mile southeast on Texas Highway 6, and 10 feet south of a roadcut in highway right-of-way:

A1—0 to 4 inches; brown (10YR 5/3) stony fine sandy loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; hard, friable; many fine roots; many worm casts; surface has about 10 percent cover of sandstone fragments; about 20 percent, by volume, sandstone fragments mostly 3 to 24 inches across the long axis; slightly acid; clear smooth boundary.

A2—4 to 6 inches; brown (7.5YR 5/4) stony fine sandy loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; hard, friable; many fine roots; many worm casts; about 20 percent, by volume, sandstone fragments mostly 3 to 24 inches across the long axis; slightly acid; clear smooth boundary.

B2t—6 to 15 inches; red (2.5YR 4/6) sandy clay, dark red (2.5YR 3/6) moist; moderate fine angular blocky structure; very hard, firm; common fine roots; continuous thin reddish brown clay films; common fine pores; common worm casts; about 10 percent,

by volume, subrounded sandstone pebbles and cobbles; slightly acid; abrupt wavy boundary.
R—15 to 35 inches; strongly cemented very pale brown sandstone; coarsely fractured; slightly acid.

The solum ranges from 10 to 20 inches in thickness. Coarse fragments of gravel and stones range from a few to about 25 percent, by volume.

The A1 horizon is dark grayish brown, brown, dark brown, pale brown, strong brown, yellowish brown, or dark yellowish brown. Reaction is neutral or slightly acid. The A2 horizon, if present, is brown, dark brown, grayish brown, light brownish gray, or yellowish brown. Reaction is neutral or slightly acid.

The B2t horizon is dark red, red, reddish brown, or dark reddish brown. It is clay loam, sandy clay, or clay. Clay content ranges from 35 to 50 percent. Reaction is slightly acid or medium acid.

The underlying sandstone is strongly cemented and is coarsely fractured in the upper part.

Frio series

The Frio series consists of deep, well drained, brownish, loamy soils. These soils formed in calcareous alluvium on flood plains. Slope ranges from 0 to 1 percent.

Typical pedon of Frio clay loam, occasionally flooded; about 20 miles south of the town of Baird on U.S. Highway 283 to the junction of U.S. Highway 283 and Farm Road 2926, this pedon is 2.1 miles east on a county road to a gate, and 63 feet south in rangeland:

A11—0 to 16 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; hard, firm; many fine roots; many worm casts; calcareous; moderately alkaline; gradual smooth boundary.
A12—16 to 27 inches; dark brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; moderate very fine subangular blocky structure; hard, firm; many fine roots; many worm casts; few threads of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.
B2—27 to 61 inches; yellowish brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; moderate fine subangular blocky structure; hard, firm; few fine roots; common fine pores; common threads of calcium carbonate increasing with depth; calcareous; moderately alkaline; gradual smooth boundary.
Cca—61 to 70 inches; brown (7.5YR 5/4) silty clay loam, brown (7.5YR 4/4) moist; massive; hard, firm; common fine pores; common concretions and films and threads of calcium carbonate; calcareous; moderately alkaline.

Average texture of the 10- to 40-inch control section is clay loam, silty clay loam, or silty clay. Clay content ranges from 35 to 45 percent. The calcium carbonate equivalent of the control section ranges from 10 to 40 percent. The soil is calcareous and moderately alkaline throughout.

The A horizon is brown, dark brown, grayish brown, dark grayish brown, or very dark grayish brown.

The B2 horizon, if present, is 1 or 2 units of value and chroma lighter than the A horizon. It is silty clay loam or silty clay.

The C horizon is yellowish brown, dark yellowish brown, light brown, brown, or light brownish gray. It is silty clay loam, clay loam, or gravelly clay loam.

Gageby series

The Gageby series consists of deep, well drained, loamy soils on flood plains. These soils formed in calcareous alluvial sediment. Slope ranges from 0 to 1 percent.

Typical pedon of Gageby loam, occasionally flooded; from the intersection of Texas Highway 36 and Texas Highway 206 in the town of Cross Plains, this pedon is 0.5 mile north on Texas Highway 206, 1.5 miles west and north on a street and county road, 0.15 mile east on pasture road, and 75 feet north of fence in a cultivated field:

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; hard, friable; common fine roots; common worm casts; calcareous; moderately alkaline; abrupt smooth boundary.
A12—6 to 16 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; hard, friable; common fine roots; common fine pores; many worm casts; calcareous; moderately alkaline; gradual smooth boundary.
A13—16 to 29 inches; brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; hard, friable; common fine roots; common fine pores; common worm casts; common films and threads of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.
B21—29 to 41 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable; common fine roots; common fine pores; common worm casts; common films and threads of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.
B22—41 to 60 inches; brown (7.5YR 5/4) loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable; calcareous; moderately alkaline.

The solum ranges from 40 to more than 60 inches in thickness. The mollic epipedon ranges from 20 to 40

inches in thickness. Depth to free carbonates ranges from 0 to 15 inches. Texture of the 10- to 40-inch control section is loam, clay loam, or sandy clay loam. Clay content ranges from 18 to 35 percent, and there is more than 15 percent coarser material than very fine sand. Some pedons contain a few fine pebbles. Organic matter content decreases irregularly with depth.

The A horizon is dark grayish brown, very dark grayish brown, grayish brown, dark brown, or brown. The upper 15 inches is mildly alkaline or moderately alkaline.

The B horizon is brown, pale brown, grayish brown, light brownish gray, or yellowish brown.

The C horizon has 5 to 15 percent, by volume, visible calcium carbonate. Texture ranges from fine sandy loam to silty clay loam. Gravel content ranges from 0 to 15 percent.

Hext series

The Hext series consists of moderately deep, well drained, loamy soils on uplands. These soils formed in calcareous, loamy earth over weakly cemented sandstone. Slope ranges from 1 to 20 percent.

Typical pedon of Hext loam, in an area of Cisco-Hext-Pedernales complex, 1 to 5 percent slopes; from the intersection of Farm Road 3146 and Texas Highway 36 at the town of Rowden, this pedon is about 0.9 mile north and 0.8 mile east on a county road, and 10 feet south in rangeland:

A1—0 to 6 inches; brown (7.5YR 5/4) loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; hard, friable; many fine roots; few limestone pebbles; common fine pores; common worm casts; calcareous; moderately alkaline; clear smooth boundary.

B2—6 to 14 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; weak coarse prismatic structure parting to weak fine subangular blocky; hard, friable; common fine roots; common fine pores; many worm casts; common concretions and films and threads of calcium carbonate; calcareous; moderately alkaline; clear wavy boundary.

B2ca—14 to 22 inches; pink (7.5YR 7/4) loam, light brown (7.5YR 6/4) moist; weak fine subangular blocky structure; hard, friable; few fine roots; common fine pores; many worm casts; many concretions, films, and threads of calcium carbonate; about 15 percent calcium carbonate equivalent; calcareous; moderately alkaline; gradual wavy boundary.

Cca—22 to 28; pinkish gray (7.5YR 7/2) loam, light brown (7.5YR 6/4) moist; massive; hard, friable; few fine roots; common fine pores; few worm casts; many concretions, films and threads, and soft masses of calcium carbonate; estimated 30 percent, by volume, weakly cemented sandstone fragments; calcareous; moderately alkaline; clear wavy boundary.

Cr—28 to 35 inches; pinkish white (7.5YR 8/2) weakly consolidated sandstone, pinkish gray (7.5YR 7/2) moist; massive; hard, becomes friable upon moistening; calcareous; moderately alkaline.

Depth to paralithic contact with weakly consolidated sandstone or siltstone ranges from 20 to 40 inches. Reaction is mildly alkaline or moderately alkaline. The calcium carbonate equivalent in the control section ranges from 8 to 40 percent.

The A horizon is dark brown, brown, grayish brown, dark grayish brown, light brownish gray, pale brown, or reddish brown. If moist value and chroma are less than 3.5, the organic matter content is less than 1 percent.

The B horizon is brown, pale brown, light yellowish brown, very pale brown, light brown, pink, or reddish brown. It is fine sandy loam, loam, or sandy clay loam. Total clay content ranges from 10 to about 25 percent, and silicate clay content ranges from 10 to 18 percent.

The Cca horizon, if present, is fine sandy loam, loam, or sandy clay loam. The upper 1 or 2 inches of the Cca horizon is weakly to strongly cemented in some pedons but ranges to friable limy earth with nodular sandstone or caliche fragments. The C horizon ranges from weakly consolidated sandstone or siltstone to sandy marl.

Leeray series

The Leeray series consists of deep, well drained, clayey soils on uplands. These soils formed in calcareous material weathered from clay and shaly clay. Slope ranges from 0 to 3 percent.

Typical pedon of Leeray clay, 1 to 3 percent slopes; from the intersection of Farm Road 2926 and U.S. Highway 283, which is 21 miles south of the town of Baird, this pedon is 1.9 miles west on Farm Road 2926, and 80 feet north of the highway in rangeland:

A11—0 to 10 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate fine granular and subangular blocky structure; very hard, very firm; many fine roots; few very fine caliche pebbles; calcareous; moderately alkaline; gradual wavy boundary.

A12—10 to 22 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate fine and medium angular blocky structure; common wedge-shaped peds; extremely hard, very firm; common fine roots; few very fine caliche pebbles; calcareous; moderately alkaline; gradual wavy boundary.

A13—22 to 43 inches; grayish brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium angular blocky structure; common wedge-shaped peds; few intersecting slickensides; extremely hard, very firm; few fine roots; few fine caliche pebbles or fragments; calcareous; moderately alkaline; diffuse wavy boundary.

AC—43 to 56 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; moderate medium angular blocky structure; common wedge-shaped peds; few intersecting slickensides; extremely hard, very firm; few very fine roots; few very fine caliche and siliceous pebbles; moderately alkaline; calcareous; diffuse wavy boundary.
C—56 to 65 inches; dark brown (7.5YR 4/4) clay; massive; very hard, very firm; common concretions of calcium carbonate; moderately alkaline; calcareous.

The solum ranges from 40 to 90 inches in thickness. When dry, these soils have cracks as much as 1 inch wide that extend from the surface to a depth of more than 20 inches. Intersecting slickensides begin at a depth of about 16 to 24 inches. Clay content ranges from 40 to about 60 percent throughout the control section. Reaction is moderately alkaline throughout.

The A horizon is grayish brown, dark grayish brown, very dark grayish brown, brown, dark brown, or very dark brown. Parts of this horizon in some pedons in microdepressions have chroma of 1 and are noncalcareous in the upper 12 inches. These parts, however, make up less than one-half of the pedon. Also, these parts are noncalcareous in the upper 12 inches. A few rounded siliceous pebbles or limestone fragments are on the surface and within the A and AC horizons of some pedons.

The AC horizon is 1 or 2 units of value and chroma lighter than the A horizon. It is silty clay or clay. Calcium carbonate concretions or soft powdery forms range from few to many.

The C or Cca horizon is brown, dark brown, light brown, pale brown, very pale brown, light brownish gray, reddish brown, or yellowish brown. In some pedons, the Cca horizon is very thin or is absent, and the soil is underlain by shale or limestone.

Lueders series

The Lueders series consists of shallow or very shallow, well drained, cobbly soils on stony uplands. These soils formed over fractured limestone bedrock. Slope ranges from 1 to 30 percent but is dominantly 1 to 8 percent.

Typical pedon of Lueders cobbly clay loam, in an area of Lueders-Speck association, undulating; from the intersection of Farm Road 2926 and U.S. Highway 283, which is 21 miles south of the town of Baird, this pedon is 2.8 miles west on Farm Road 2926 to intersection with road at a curve, 270 feet west of a gate on a private road, and 90 feet north in rangeland:

A1—0 to 8 inches; dark grayish brown (10YR 4/2) cobbly clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; hard, friable; many fine roots; common worm casts; about 15 percent of surface covered with cobblestones and gravel-size fragments of very hard limestone; about 10 percent, by volume, limestone gravel and 25 percent limestone cobbles; calcareous; moderately alkaline; clear irregular boundary.
A1ca—8 to 14 inches; dark grayish brown (10YR 4/2) very cobbly clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular and subangular blocky structure; hard, friable; many fine roots; common worm casts; about 65 percent, by volume, cobble- and gravel-size limestone fragments; few hard gravel-size caliche fragments; hard, thin layer of calcium carbonate pendants on lower side of most limestone fragments; calcareous; moderately alkaline; abrupt wavy boundary.
R—14 to 20 inches; fractured limestone bedrock coated with caliche in upper few inches.

The solum ranges from 7 to 20 inches in thickness. It has limestone fragments throughout that are mostly less than 10 inches in diameter. The A11 horizon has 10 to 50 percent fragments, and the A12 horizon has 60 to 90 percent. Most fragments within the A12ca horizon have pendants of carbonates on their lower sides.

The A horizon is grayish brown, dark grayish brown, very dark grayish brown, brown, or dark brown. The fine earth fraction is silty clay loam, loam, or clay loam. Clay content ranges from 25 to 35 percent.

The R layer is limestone that is layered and fractured and has carbonate coatings in the upper part. Olive or grayish clay is between some of the limestone layers.

Mereta series

The Mereta series consists of shallow, well drained, loamy soils on uplands. These soils formed in calcareous old alluvium or from chalky marine sediment. Slope ranges from 1 to 3 percent.

Typical pedon of Mereta clay loam, 1 to 3 percent slopes; from the Shackleford-Callahan County line marker on Farm Road 604 north of the town of Clyde, this pedon is 0.4 mile south on Farm Road 604 to an unpaved county road, 0.2 mile south on county road to intersection with another county road, 850 feet west on the county road, and 348 feet north in a cultivated field:

Ap—0 to 5 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; hard, friable; common fine caliche fragments; few fine caliche pebbles; calcareous; moderately alkaline; abrupt smooth boundary.
A12—5 to 16 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; hard, firm; common very fine roots; common fine and very fine pores; common worm casts; common very fine caliche fragments; few gravel-size caliche fragments in lower part; calcareous; moderately alkaline; abrupt wavy boundary.

C1cam—16 to 22 inches; pinkish white (7.5YR 8/2) strongly cemented caliche, pink (7.5YR 7/4) moist; weak platy to massive; extremely hard; calcareous; moderately alkaline; clear wavy boundary.
C2ca—22 to 60 inches; pink (5YR 8/3) loam, pink (5YR 7/4) moist; massive; hard, friable; about 10 percent siliceous pebbles; about 50 percent, by volume, concretions and soft masses of calcium carbonate.

The solum ranges from 14 to 20 inches in thickness over strongly cemented caliche. Texture of the control section is mainly clay loam. Clay content ranges from 35 to 40 percent. Coarse fragments in the control section range from a few to about 10 percent, by volume. These soils are calcareous and moderately alkaline throughout.

The A horizon is dark brown, very dark grayish brown, brown, grayish brown, or dark grayish brown. In some pedons the A12 horizon is reddish brown or dark reddish brown.

The C1cam horizon ranges from strongly cemented to indurated and from massive to platy. The C2ca horizon is limy, loam or clay loam marl which is high in calcium carbonate. Siliceous and caliche pebbles make up from 2 to about 15 percent, by volume.

Nukrum series

The Nukrum series consists of deep, well drained, clayey soils on uplands, in valleys, and on terraces. These soils formed in outwash material. Slope ranges from 1 to 5 percent.

Typical pedon of Nukrum clay, 1 to 3 percent slopes; from the intersection of Texas Highway 36 and Farm Road 2287 west of the town of Cross Plains, this pedon is 0.1 mile south and 6.85 miles west on Farm Road 2287, and 10 feet north of highway right-of-way in a cultivated field:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; weak fine and very fine subangular blocky structure; hard, firm; common fine roots; few fine siliceous pebbles; calcareous; moderately alkaline; abrupt smooth boundary.
A1—7 to 39 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate fine and medium blocky structure; very hard, firm; few fine roots; vertical streaks, apparently from dry weather cracks, extend to a depth of more than 20 inches; few fine siliceous pebbles; few fine concretions and few fine soft masses of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.
B2—39 to 65 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate fine and medium blocky structure; very hard, firm; common very fine concretions of calcium carbonate; few fine films and soft masses of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.
Cca—65 to 70 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; massive; very hard, firm, sticky; about 4 percent, by volume, very fine soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 40 to 72 inches in thickness. When dry, the soils have cracks 0.4 inch to 1.2 inches wide that extend from the surface to a depth of more than 20 inches. The control section is silty clay, clay, or clay loam that is about 38 to 60 percent clay.

The A horizon is very dark grayish brown, dark grayish brown, dark brown, brown, reddish brown, or dark reddish gray. Moist value and chroma are less than 3.5. Thickness of the A horizon ranges from 20 to 58 inches.

The B horizon is brown, grayish brown, yellowish brown, or reddish brown. Concretions and soft masses of calcium carbonate range from less than 1 percent to about 5 percent, by volume.

The Cca horizon is light brownish gray, brown, pale brown, very pale brown, or reddish brown. It is silty clay loam, silty clay, clay loam, clay, or shaly clay. Content of secondary calcium carbonate ranges from 2 to 20 percent.

Nuvalde series

The Nuvalde series consists of deep, well drained, loamy soils on uplands, in valleys, and on terraces. These soils formed in thick beds of calcareous, loamy outwash sediment. Slope ranges from 1 to 3 percent.

Typical pedon of Nuvalde clay loam, 1 to 3 percent slopes; at the intersection of Texas Highway 36 and Farm Road 1178 north of the community of Dudley, this pedon is 78 feet east of Texas Highway 36 and 72 feet north of church property in a cultivated field:

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; hard, friable; many very fine roots; common worm casts; few very fine pebbles of quartz and limestone; calcareous; moderately alkaline; abrupt smooth boundary.
A1—5 to 15 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, friable; common very fine roots; common worm casts; few very fine pebbles of quartz and limestone; few films and threads of calcium carbonate in lower part; calcareous; moderately alkaline; clear smooth boundary.
B21ca—15 to 36 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate fine subangular blocky structure; hard, friable; common very fine roots; common worm casts; very fine siliceous pebbles; few concretions

and common films, threads, and soft masses of calcium carbonate; 20 percent calcium carbonate equivalent; calcareous; moderately alkaline; gradual smooth boundary.

B22ca—36 to 49 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; moderate fine subangular blocky structure; hard, friable; few very fine roots; many fine pores; common very fine concretions and many films, threads, and soft masses of calcium carbonate; 20 percent calcium carbonate equivalent; calcareous; moderately alkaline; gradual smooth boundary.

Cca—49 to 60 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; massive; hard, friable; few concretions and common films and threads of calcium carbonate; 15 percent calcium carbonate equivalent; calcareous; moderately alkaline.

The solum ranges from 25 to 50 inches in thickness. The mollic epipedon ranges from 10 to 20 inches in thickness.

The A horizon is dark grayish brown, grayish brown, brown, or dark brown.

The B2ca horizon is brown, pale brown, grayish brown, or very pale brown. The amount of visible carbonates in the form of concretions and films and threads ranges from 5 to 20 percent, by volume. Texture is loam, silty clay loam, or clay loam. Noncarbonate clay ranges from 18 to about 30 percent. Calcium carbonate equivalent ranges from 15 to 40 percent.

The Cca horizon ranges from pink to pale brown and is from 15 to 60 percent calcium carbonate equivalent. It is loam, silty clay loam, sandy clay loam, or clay loam.

These Nuvalde soils are taxadjuncts to the Nuvalde series because the control section is typically about 20 percent sand coarser than very fine sand. This difference, however, does not affect use, management, and behavior.

Oplin series

The Oplin series consists of shallow or very shallow, well drained, gravelly and flaggy soils on stony uplands. These soils formed over fractured limestone bedrock. Slope ranges from 1 to 30 percent but is dominantly 1 to 8 percent.

Typical pedon of Oplin very flaggy clay loam, in an area of Oplin-Speck association, undulating; from the intersection of Texas Highway 206 and Texas Highway 36 in the town of Cross Plains, this pedon is 4 miles northeast on Texas Highway 206, 1.5 miles north and west on a county road to its junction with another county road, 2.8 miles north on county road, and 5 feet west in rangeland:

A1—0 to 5 inches; brown (10YR 5/3) very flaggy clay loam, dark brown (10YR 3/3) moist; moderate fine granular structure; hard, friable; many fine roots; common worm casts; about 40 percent of surface covered with cobblestones and gravel-size fragments of limestone; about 25 percent, by volume, limestone gravel and 25 percent flagstones; calcareous; moderately alkaline; clear irregular boundary.

A1ca—5 to 9 inches; brown (10YR 5/3) very flaggy clay loam, dark brown (10YR 3/3) moist; moderate fine granular structure; hard, friable; many fine roots; common worm casts; about 65 percent, by volume, limestone fragments, 20 percent of which are gravel-size, and about 45 percent of which are flagstone size; coatings of calcium carbonate pendants on lower sides of limestone fragments; calcareous; moderately alkaline; abrupt wavy boundary.

R&Cca—9 to 15 inches; fractured, layered, limestone bedrock; secondary calcium carbonate coatings on rocks and partially plugging the seams; diffuse boundary.

R—15 to 30 inches; fractured, platy, indurated limestone bedrock.

The solum and commonly the depth to bedrock range from 7 to 20 inches in thickness. The control section has from 35 to 80 percent limestone fragments that are less than 10 inches across the long axis.

The A horizon is grayish brown, dark grayish brown, very dark grayish brown, brown, or dark brown. The fine earth fraction is clay loam. Coarse fragments range from 15 to 65 percent in the A1 horizon and from 50 to 80 percent in the A1ca horizon. Most fragments in the A1ca horizon have pendants of calcium carbonate on the lower side. Content of calcium carbonate ranges from 10 to 30 percent in the fine earth fraction less than 2 millimeters in size.

The R layer is indurated limestone. It is layered and fractured and has calcium carbonate coatings in the upper part.

Owens series

The Owens series consists of shallow, well drained, clayey soils on uplands. These soils formed in calcareous, clayey shale. Slope ranges from 1 to 30 percent.

Typical pedon of Owens stony clay, in an area of Owens-Throck association, hilly; from the intersection of U.S. Highway 283 and Highway 425 in the town of Baird, this pedon is 5.6 miles south on U.S. Highway 283, and 27 feet west of the highway in rangeland:

A1—0 to 3 inches; brown (7.5YR 5/4) stony clay, brown (7.5YR 4/4) moist; moderate very fine subangular blocky structure; very hard, firm; many fine roots; 35 percent cover of limestone cobbles, pebbles, and stones on surface; calcareous; moderately alkaline; clear smooth boundary.

B21ca—3 to 10 inches; light yellowish brown (10YR 6/4) clay, yellowish brown (10YR 5/4) moist; few fine

faint brown (7.5YR 5/4) mottles; moderate fine blocky structure; very hard, very firm; common fine roots; few soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B22ca—10 to 17 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; common distinct light yellowish brown (10YR 6/4) mottles; weak medium blocky structure; extremely hard, very firm; few very fine roots; few threads and films and very fine soft masses of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

Cr—17 to 30 inches; light brownish gray (10YR 6/2) shaly clay, grayish brown (10YR 5/2) moist; common seams and pockets of pale red (2.5YR 6/2); massive; extremely hard, very firm; few very fine concretions and soft masses of calcium carbonate in upper few inches; calcareous; moderately alkaline.

The solum ranges from 10 to 20 inches in thickness. In some pedons the A horizon is noncalcareous.

The A horizon is brown, light brownish gray, light reddish brown, or reddish brown. Limestone or sandstone fragments are on the surface and in the upper part of the A horizon in most pedons.

The B2 horizon is light brownish gray, light yellowish brown, pale brown, reddish brown, light reddish brown, or weak red. These colors apparently reflect the variety of colors of the parent material. Brownish or yellowish mottles may be present. Calcium carbonate in the B2ca horizon ranges from barely visible films and threads to about 5 percent, by volume, soft powdery bodies.

The Cr horizon ranges from olive to weak red, shaly clay, clayey shale, or weakly consolidated shale.

Patilo series

The Patilo series consists of deep, moderately well drained, sandy soils on uplands. These soils formed in thick beds of sandy material. Slope ranges from 1 to 5 percent.

Typical pedon of Patilo fine sand, in an area of Demona-Patilo complex, 1 to 5 percent slopes; from the intersection of U.S. Highway 283 and Texas Highway 425 in the town of Baird, this pedon is about 7.5 miles south on U.S. Highway 283 to intersection with a county road, 1.1 miles east on county road, and 27 feet south in pastureland:

A1—0 to 5 inches; pale brown (10YR 6/3) fine sand, brown (10YR 4/3) moist; single grained; soft, very friable; common fine roots; neutral; clear smooth boundary.

A2—5 to 58 inches; very pale brown (10YR 7/4) fine sand, light yellowish brown (10YR 6/4) moist; single grained; loose; few fine roots; neutral; clear wavy boundary.

B21t—58 to 66 inches; light gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; many medium prominent yellowish red (5YR 5/6) mottles; strong coarse prismatic structure parting to weak medium blocky; very hard, firm; coarse peds are coated with light gray fine sand; few clay films on surfaces of peds; slightly acid; gradual smooth boundary.

B22t—66 to 80 inches; light gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; common medium prominent red (2.5YR 5/6) and few medium distinct strong brown (7.5YR 5/6) mottles; moderate coarse blocky structure; very hard, friable; few clay films on surfaces of peds; medium acid.

The solum ranges from 65 to more than 100 inches in thickness.

The A horizon ranges from 40 to 80 inches in thickness. Reaction ranges from neutral to medium acid. The A1 horizon is grayish brown, brown, light brownish gray, pale brown, or very pale brown. The A2 horizon is brown, very pale brown, light gray, white, or light yellowish brown.

The B2t horizon is dominantly sandy clay loam, and reaction ranges from slightly acid to strongly acid. This horizon is light gray, very pale brown, pale brown, light yellowish brown, reddish yellow, or yellowish red with varied sizes and amounts of red, yellow, and gray mottles.

Pedernales series

The Pedernales series consists of deep, well drained, loamy and sandy soils on uplands. These soils formed in thick beds of clayey and loamy material. Slope ranges from 1 to 8 percent.

Typical pedon of Pedernales fine sandy loam, 1 to 3 percent slopes; this pedon is 1 mile west of the town of Cottonwood on a county road to an intersection, 4 miles north and west on county road to an intersection, 0.3 mile north on county road to pasture road entrance, and 170 feet east in wooded pastureland:

A1—0 to 7 inches; brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; hard, friable; many fine roots; mildly alkaline; clear smooth boundary.

B21t—7 to 21 inches; red (2.5YR 4/6) sandy clay, dark red (2.5YR 3/6) moist; moderate fine and medium blocky structure; very hard, firm; many fine roots and few medium roots; darker clay films on faces of peds; neutral; gradual wavy boundary.

B22t—21 to 40 inches; red (2.5YR 5/8) sandy clay, red (2.5YR 4/6) moist; moderate medium blocky structure; very hard, firm; common fine roots; darker clay films on faces of peds; few fine bodies of calcium carbonate in lower part; mildly alkaline; gradual wavy boundary.

B3ca—40 to 53 inches; red (2.5YR 5/6) sandy clay loam, red (2.5YR 4/6) moist; moderate medium subangular blocky structure; very hard, firm; few fine roots; few clay films; 20 percent soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

Cca—53 to 70 inches; reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; massive; hard, firm; few fine pores; 20 percent concretions and soft masses of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 35 to 60 inches in thickness. Secondary carbonates are at a depth of 28 to 50 inches.

The A horizon is fine sandy loam or loamy fine sand. It is reddish brown, yellowish red, brown, light brown, or pale brown. Reaction ranges from slightly acid to mildly alkaline.

The B2t and B3 horizons are red, reddish brown; yellowish red, or reddish yellow. Yellowish and brownish mottles are present in some pedons. The B2t horizon is sandy clay or clay. Reaction ranges from slightly acid to mildly alkaline, and in some pedons it is moderately alkaline in the lower part. The B3ca horizon is sandy clay loam, clay loam, or sandy clay.

The Cca horizon is sandy clay loam, clay loam, or sandy clay. Thin strata of soft limestone or soft sandstone are in some pedons. This horizon is light red, light reddish brown, pink, light brown, reddish brown, reddish yellow, or very pale brown. Soft powdery masses and concretions of calcium carbonate range from 5 to 30 percent, by volume. The content of calcium carbonate does not decrease with depth.

Rowden series

The Rowden series consists of moderately deep, well drained, loamy soils on uplands. These soils formed in clayey material over limestone. Slope ranges from 1 to 3 percent.

Typical pedon of Rowden clay loam, 1 to 3 percent slopes; from the intersection of Texas Highway 36 and Farm Road 2287 west of the town of Cross Plains, this pedon is 0.1 mile south and 5.7 miles west on Farm Road 2287, and 10 feet north in a cultivated field:

Ap—0 to 8 inches; dark brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; hard, friable; many very fine roots; common worm casts; few fine quartz and chert pebbles; calcareous; moderately alkaline; clear smooth boundary.

B21t—8 to 15 inches; reddish brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; moderate medium blocky structure; very hard, firm; common very fine roots; common worm casts; thin patchy clay films on faces of peds; few fine quartz and chert pebbles; matrix is noncalcareous; moderately alkaline; clear wavy boundary.

B22t—15 to 27 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; strong medium blocky structure; very hard, firm; few very fine roots; few worm casts; thin patchy clay films on faces of peds; few fine quartz and chert pebbles; few threads and films of calcium carbonate in lower 2 inches; calcareous; moderately alkaline; abrupt wavy boundary.

R—27 to 32 inches; indurated, light reddish brown limestone bedrock; coarsely fractured; thin calcium carbonate coatings on surface of bedrock and in fractures.

The solum ranges from 20 to 40 inches in thickness. The lower boundary of the solum may rest abruptly on limestone bedrock or grade into bedded limestone with soil in the interstices. Content of coarse fragments and gravel ranges from 0 to 15 percent in the A and Bt horizons.

The A horizon is dark grayish brown, dark brown, brown, dark reddish gray, or reddish brown. Reaction ranges from neutral to moderately alkaline.

The B21t horizon is dark brown, brown, reddish brown, dark reddish brown, or dark reddish gray clay loam or clay. Clay content ranges from 35 to 60 percent. The B22t horizon is brown, reddish brown, or dark reddish brown clay loam or clay. Clay content ranges from 35 to 60 percent. Reaction is mildly alkaline or moderately alkaline.

The limestone in the R horizon is pink to reddish brown and has a hardness of 3 or 4 on the Mohs' scale.

Rowena series

The Rowena series consists of deep, well drained, loamy soils on uplands and plains and in valleys. These soils formed in calcareous clay loam and clay sediment. Slope ranges from 0 to 3 percent.

Typical pedon of Rowena clay loam, 0 to 1 percent slopes; from the Taylor-Callahan County line marker on Texas Highway 351 in the northwest corner of Callahan County, this pedon is 0.1 mile southwest on Texas Highway 351 to intersection with a paved road, 0.5 mile south on paved road to intersection with a county road; 0.1 mile east on county road, and 90 feet north in a cultivated field:

Ap—0 to 6 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; weak very fine subangular blocky structure; hard, firm, sticky; common very fine roots; few very fine caliche fragments; calcareous; moderately alkaline; abrupt smooth boundary.

B21—6 to 24 inches; dark brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate fine and medium angular blocky structure; very hard, firm, sticky; few very fine roots; shiny pressure faces on peds; evidence of cracks extends below a depth of

20 inches; few very fine caliche fragments; few films and threads of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.
B22ca—24 to 46 inches; reddish brown (5YR 5/3) clay, reddish brown (5YR 4/3) moist; moderate fine subangular blocky structure; very hard, firm, sticky; about 10 percent, by volume, soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; abrupt wavy boundary.
Cca—46 to 60 inches; reddish yellow (5YR 6/6) silty clay loam, yellowish red (5YR 5/6) moist; massive; slightly hard, friable; about 30 percent films, soft masses, and weakly and strongly cemented concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 22 to 48 inches in thickness. The COLE exceeds 0.07. When the soil is dry, cracks that are 1 centimeter to 3 centimeters wide extend from the surface to a depth of 20 to 30 inches. Distinct calcium carbonate accumulations are at a depth of 24 to 40 inches.

The A and B21 horizons are grayish brown, brown, dark grayish brown, very dark grayish brown, or dark brown. The B22 horizon is grayish brown, dark grayish brown, brown, or reddish brown. The B21 and B22 horizons are clay loam or clay. Clay content ranges from 35 to 50 percent and is slightly higher than that of the A horizon. Some of the more deeply developed pedons have a B22ca horizon with a calcic horizon.

The Cca horizon is pink, light reddish brown, light brown, reddish yellow, or yellowish red silty clay loam, clay loam, or clay.

Sagerton series

The Sagerton series consists of deep, well drained, loamy soils on uplands and plains and in valleys. These soils formed in calcareous, clayey sediment. Slope ranges from 0 to 3 percent.

Typical pedon of Sagerton loam, 1 to 3 percent slopes; from the intersection of Texas Highway 36 and U.S. Highway 283, 12 miles south of the town of Baird, this pedon is 2.4 miles south on U.S. Highway 283, and 50 feet west of highway right-of-way in a cultivated field:

Ap—0 to 7 inches; dark brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; moderate very fine subangular blocky structure; hard, friable; common fine roots; few fine siliceous pebbles; mildly alkaline; abrupt smooth boundary.
B21t—7 to 12 inches; reddish brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; moderate fine subangular blocky structure; very hard, firm; common fine roots; clay films on faces of peds; few fine siliceous pebbles; moderately alkaline; gradual smooth boundary.
B22t—12 to 25 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate medium blocky structure; very hard, very firm; few fine roots; continuous clay films; few fine siliceous and chert pebbles; mildly alkaline; gradual smooth boundary.
B23t—25 to 40 inches; yellowish red (5YR 4/6) clay, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; very hard, very firm; few fine roots; patchy clay films; few films and threads of calcium carbonate; few fine siliceous and chert pebbles; calcareous; moderately alkaline; gradual smooth boundary.
B24tca—40 to 65 inches; reddish yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; weak medium subangular blocky structure; very hard, firm; common fine pores; about 35 percent soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 60 to over 80 inches in thickness. Depth to secondary carbonates ranges from 20 to 28 inches. A distinct calcic horizon is at a depth of 30 to 60 inches.

The A horizon is reddish brown, dark reddish gray, brown, dark brown, or grayish brown. Reaction is neutral or mildly alkaline.

The Bt horizon is clay or clay loam throughout. The average clay content in the upper 20 inches ranges from about 35 to 45 percent. Reaction ranges from neutral to moderately alkaline in the upper part of the Bt horizon and is moderately alkaline in the lower part.

Colors in the B21t horizon are similar to those in the A horizon. The B22t and B23t horizons are light reddish brown, reddish brown, red, reddish yellow, yellowish red, or brown. The B24tca horizon is pink or reddish yellow. The calcic horizon (B2tca horizon) has an estimated 20 to 50 calcium carbonate equivalent, mostly in the form of soft masses and concretions.

In some mapped areas there are soils that are closely similar to Sagerton soils. Some do not have carbonates in the upper 28 inches, some have a significant decrease in clay in the lower part of the subsoil, some have a solum less than 60 inches thick, and some have chroma of 4 or less throughout.

Speck series

The Speck series consists of shallow, well drained, loamy soils. These soils formed over limestone. Slope ranges from 1 to 8 percent.

Typical pedon of Speck clay loam, 1 to 3 percent slopes; from the intersection of Texas Highway 36 and Farm Road 3146 in the town of Rowden, this pedon is about 1 mile south on Farm Road 3146 to an intersection with a county road, 0.8 mile west on county road and 78 feet south of county road right-of-way in native pastureland:

A1—0 to 7 inches; brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate fine subangular

blocky structure; hard, firm; many fine roots; few fine pebbles of quartz and chert; slightly acid; clear smooth boundary.

B2t—7 to 18 inches; reddish brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; moderate fine and medium blocky structure; very hard, very firm; common fine roots; thin clay films on surfaces of peds; few fine pebbles of quartz and chert; common concretions of calcium carbonate and limestone gravel in lower 3 inches; moderately alkaline; abrupt irregular boundary.

R—18 to 22 inches; light brown, fractured limestone bedrock.

Thickness of the solum and depth to limestone bedrock range from 14 to 20 inches. A few to 25 percent coarse fragments cover the surface and make up a similar range, by volume.

The A horizon is very dark brown, very dark grayish brown, dark grayish brown, dark brown, brown, or reddish brown.

The B2t horizon is reddish brown, dark reddish brown, or brown clay, clay loam, or their cobbly or stony counterparts. Clay content ranges from 35 to 60 percent. Secondary lime is within the Bt horizon as concretions immediately above the limestone bedrock or as coatings on the surfaces of fragments and in fractures of the bedrock in some pedons.

The R horizon is limestone bedrock or bedded limestone with soil in the interstices.

Throck series

The Throck series consists of moderately deep, well drained, loamy soils on uplands. These soils formed in clayey marl and shaly clay. Slope ranges from 2 to 30 percent.

Typical pedon of Throck stony clay loam, in an area of Throck-Speck association, undulating; from the intersection of Farm Road 880 and Farm Road 2945 east of the town of Putnam, this pedon is about 5.5 miles north on Farm Road 880 to an intersection with a county road, 2.8 miles west on county road to an intersection with another county road, 0.7 mile north on county road to an intersection with another county road, 0.25 mile east on road, and 850 feet north in rangeland:

A1—0 to 6 inches; grayish brown (10YR 5/2) stony clay loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; hard, friable; common worm casts; few fine limestone pebbles; few scattered limestone fragments and stones 3 to 15 inches in diameter on surface; calcareous; moderately alkaline; clear smooth boundary.

B21—6 to 15 inches; brown (10YR 5/3) silty clay loam, brown (10YR 4/3) moist; moderate fine subangular blocky structure; hard, firm; common worm casts; few fine limestone pebbles; calcareous; moderately alkaline; clear smooth boundary.

B22ca—15 to 23 inches; light yellowish brown (10YR 6/4) silty clay loam, yellowish brown (10YR 5/4) moist; moderate fine subangular blocky structure; hard, firm; about 10 percent, by volume, concretions and soft masses of calcium carbonate; about 2 percent limestone fragments mostly 2 inches thick and 10 inches in diameter; about 25 percent calcium carbonate equivalent; calcareous; moderately alkaline; clear smooth boundary.

B23ca—23 to 30 inches; light yellowish brown (10YR 6/4) silty clay loam, yellowish brown (10YR 5/4) moist; moderate fine subangular blocky structure; hard, firm; about 5 percent, by volume, concretions and soft masses of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

Cr—30 to 42 inches; light yellowish brown (10YR 6/4) shaly silty clay; massive, breaking into thin platy fragments; calcareous; moderately alkaline.

The solum ranges from 21 to 50 inches in thickness. Clay content of the control section is 35 to 45 percent. Most pedons are calcareous throughout.

The A horizon is dark grayish brown, grayish brown, or brown. Fragments of limestone make up as much as 15 percent, by volume.

The B2 horizon is dark yellowish brown, grayish brown, yellowish brown, brown, or light yellowish brown. It is silty clay loam, clay loam, silty clay, or clay. Fragments of limestone vary from a few to 30 percent, by volume, and are mostly less than 3 inches.

The Bca horizon is light yellowish brown, yellowish brown, reddish yellow, strong brown, pale brown, or very pale brown clay loam, silty clay loam, silty clay, or clay. Content of calcium carbonate is 15 to 40 percent.

The C horizon is light gray, olive gray, olive, light yellowish brown, dark reddish gray, or gray, shaly clay or silty clay. Interbedded strata of limestone 2 to 24 inches thick are in most pedons at a depth of 40 to 80 inches.

formation of the soils

In this section the factors of soil formation are discussed and related to the soils in the survey area. The characteristics of the soil at any given point are determined by the physical and mineral composition of the parent material; the climate under which the parent material accumulated and has existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time the forces of soil formation have acted on the soil material. All five of these factors influence the present characteristics of every soil, but the significance of each factor varies from one place to another. In one area one factor may dominate the formation of a soil, and in another area a different factor may be more important.

The interrelationship among these five factors is complex; and the effects of any one factor cannot be isolated and completely evaluated. Each factor and the probable effects of each factor are discussed separately.

climate

Callahan County has a subhumid, temperate, continental climate. The subhumid climate has promoted moderately rapid soil development. Climate is uniform throughout the county, but its effect on the soils has been modified locally by relief and runoff.

living organisms

Plants, micro-organisms, earthworms, and other forms of animal life are important in the formation of the soils. Grasses and hardwood plants probably have affected soil formation in the survey area more than other living organisms. Soils that generally are low in content of organic matter, such as Cisco and Demona soils, formed under a hardwood type of vegetation. Soils that are generally high in organic matter, such as Abilene, Nukrum, and Leeray soils, mainly formed under grasses.

parent material

Parent material is the unconsolidated soil material from which the soils formed. It determines the limits of the chemical and mineralogical composition of the soil. In Callahan County, the soils formed in material from three different geological systems. They are the Permian, Cretaceous, and Quaternary Systems (*3*).

Materials of the Permian System are mainly interbedded shale, limestone, and sandstone of the Wichita and Cisco Groups. Sandstone is mainly limited to that part of the Cisco Group in the northeastern corner of the county. The Wichita Group is dominated by limestone and limy shale. The Bonti and Exray soils formed in material weathered from acid sandstone, and the Callahan, Owens, and Throck soils formed in material weathered from shale. The Lueders, Rowden, and Speck soils formed in material weathered from limestone. Several rock formations of the Permian Age cross Callahan County. The oldest formation is on the eastern side of the county, and the youngest is on the western side (*7*). These formations lie in a north-south direction, and several of them form prominent east-facing escarpments.

The most outstanding topographic features are the mesa-like mountains and hills known as the Callahan Divide. These hills are capped with Cretaceous limestone of the Fredericksburg Group. Examples are East and West Caddo Peaks and Spring Mesa, northwest of Cross Plains; Tecumseh Peak, near Oplin; and Eagle Mountain, near the Denton community in the western part of the county. Oplin soils formed where the limestone bedrock is near the surface, mainly in Comanche Peak Limestone. Minor areas are in Edwards Limestone. Most of the Brackett soils formed in the marl and soft limestone of the Walnut Formation. Antlers Sand of the Trinity Group covered the entire county to a depth of several hundred feet about 60 million years ago. With the exception of about 30 percent of the county, this Cretaceous material has been removed by geologic erosion. Antlers Sand is dominantly poorly cemented sandstone and scattered lentils of clay and calcareous, loamy material. The Cisco, Chaney, Demona, Hext, Patilo, Pedernales, and associated soils formed on Antlers Sand.

Loamy and clayey material of the Quaternary System makes up the valleys and outwash plains of the county. Soils that formed on outwash plains are Abilene, Cho, Mereta, Leeray, Nuvalde, Rowena, Sagerton, and associated soils. The parent material of soils on flood plains of streams consists of recent deposits of alluvium. Soils that formed in these deposits are the moderately alkaline Frio and Gageby soils.

topography

Topography, or relief, affects soil formation through its influence on drainage, runoff, erosion, plant cover, and

soil temperature. The topography of the survey area ranges from gently sloping plains to broad, interstream divides with strongly sloping side slopes.

Soils that formed in gently sloping areas, such as the Chaney and Pedernales soils, are deeper and have more distinct horizons than soils that formed on hillsides and ridges, such as the Brackett and Throck soils. The soils in lower lying positions on the landscape are deeper and have more distinct horizons than other soils because they receive extra water, have less runoff, and are subject to less erosion.

time

A long time is generally necessary for the formation of soils with distinct horizons. The differences in the length of time that parent material has been in place, therefore, commonly reflect the degree of development of the soil profile.

The soils in the survey area range from young to old. The young soils have very little profile development, but the old soils have well expressed horizons. Gageby soils are an example of young soils that have little development. Except for an accumulation of organic matter and darkening of the surface layer, Gageby soils have retained most of the characteristics of their loamy parent material. Pedernales soils are an example of older soils that have well developed horizons. These soils have developed a distinct surface layer and subsoil that bear little resemblance to the original parent material.

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glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—
Loose.—Noncoherent when dry or moist; does not hold together in a mass.
Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Gilgai. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the

soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Motte. A clump of trees in a prairie.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction

because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and

are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1964-76 at Putnam, Texas]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January	57.9	33.0	45.5	84	5	56	1.60	.02	2.70	2	1.7
February	61.6	35.8	48.7	82	15	94	1.39	.49	2.11	3	1.0
March	70.2	43.4	56.8	91	19	299	1.37	.26	2.21	3	1.8
April	78.6	53.7	66.2	96	29	486	2.68	.98	4.04	4	.0
May	84.2	59.8	72.0	99	42	682	2.86	.89	4.42	4	.0
June	91.4	67.2	79.3	102	52	879	2.24	.51	3.59	3	.0
July	95.4	71.0	83.2	105	60	1,029	1.61	.14	2.69	3	.0
August	94.0	69.4	81.7	105	59	983	3.00	.57	4.90	5	.0
September	85.4	63.1	74.3	99	43	729	3.78	1.95	5.26	5	.0
October	77.1	53.0	65.1	94	35	468	2.82	.71	4.50	4	.0
November	66.3	43.7	55.0	83	22	222	1.59	.25	2.59	3	1.6
December	59.8	35.6	47.7	80	11	55	1.00	.15	1.64	2	.1
Yearly:											
Average	76.8	52.4	64.6	---	---	---	---	---	---	---	---
Extreme	---	---	---	107	5	---	---	---	---	---	---
Total	---	---	---	---	---	5,982	25.94	21.20	30.43	41	6.2

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1964-76 at Putnam, Texas]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	March 14	April 5	April 7
2 years in 10 later than--	March 8	March 31	April 4
5 years in 10 later than--	February 24	March 20	March 28
First freezing temperature in fall:			
1 year in 10 earlier than--	November 12	November 6	October 26
2 years in 10 earlier than--	November 21	November 14	November 1
5 years in 10 earlier than--	December 9	November 28	November 14

TABLE 3.--GROWING SEASON

[Recorded in the period 1964-76 at Putnam, Texas]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	273	226	212
8 years in 10	278	235	218
5 years in 10	287	252	230
2 years in 10	297	269	242
1 year in 10	302	278	248

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1	Abilene loam, 0 to 1 percent slopes	5,250	0.9
2	Abilene loam, 1 to 3 percent slopes	4,140	0.7
3	Bonti fine sandy loam, 1 to 3 percent slopes	1,510	0.3
4	Bonti-Callahan-Exray complex, 1 to 8 percent slopes	2,470	0.5
5	Callahan loam, 1 to 3 percent slopes	2,630	0.5
6	Callahan loam, 2 to 5 percent slopes, eroded	3,190	0.6
7	Chaney loamy fine sand, 1 to 3 percent slopes	32,930	6.0
8	Chaney stony sandy loam, 1 to 8 percent slopes	7,500	1.4
9	Chaney Variant loamy fine sand, 0 to 1 percent slopes	360	0.1
10	Cho gravelly loam, 1 to 5 percent slopes	1,170	0.2
11	Cisco loamy fine sand, 1 to 3 percent slopes	1,380	0.3
12	Cisco fine sandy loam, 1 to 3 percent slopes	3,530	0.6
13	Cisco fine sandy loam, 1 to 5 percent slopes, eroded	9,470	1.7
14	Cisco-Hext-Pedernales complex, 1 to 5 percent slopes	9,720	1.8
15	Cisco-Hext-Pedernales association, undulating	13,960	2.5
16	Demona-Patilo complex, 1 to 5 percent slopes	11,070	2.0
17	Frio clay loam, occasionally flooded	10,100	1.8
18	Frio-Gageby association, frequently flooded	20,850	3.8
19	Gageby loam, occasionally flooded	9,230	1.7
20	Hext-Oplin-Brackett association, hilly	11,930	2.2
21	Leeray clay, 0 to 1 percent slopes	2,040	0.4
22	Leeray clay, 1 to 3 percent slopes	19,860	3.6
23	Lueders-Speck association, undulating	57,520	10.5
24	Mereta clay loam, 1 to 3 percent slopes	2,830	0.5
25	Nukrum clay, 1 to 3 percent slopes	13,950	2.5
26	Nukrum clay, 3 to 5 percent slopes	1,870	0.3
27	Nuvalde clay loam, 1 to 3 percent slopes	5,340	1.0
28	Oplin-Speck association, undulating	4,680	0.8
29	Owens-Throck association, hilly	14,240	2.6
30	Pedernales loamy fine sand, 1 to 3 percent slopes	7,430	1.4
31	Pedernales fine sandy loam, 1 to 3 percent slopes	22,540	4.1
32	Pedernales fine sandy loam, 1 to 3 percent slopes, eroded	19,540	3.6
33	Pits	550	0.1
34	Rowden clay loam, 1 to 3 percent slopes	12,740	2.3
35	Rowena clay loam, 0 to 1 percent slopes	2,590	0.5
36	Rowena clay loam, 1 to 3 percent slopes	4,140	0.8
37	Sagerton loam, 0 to 1 percent slopes	1,080	0.2
38	Sagerton loam, 1 to 3 percent slopes	21,580	3.9
39	Speck clay loam, 1 to 3 percent slopes	10,270	1.9
40	Speck-Throck association, gently undulating	26,510	4.8
41	Throck clay loam, 2 to 5 percent slopes	4,230	0.8
42	Throck-Callahan-Owens association, undulating	32,670	6.0
43	Throck-Owens-Lueders association, hilly	50,340	9.2
44	Throck-Speck association, undulating	46,910	8.5
	Water	640	0.1
	Total	548,480	100.0

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Map symbol and soil name	Cotton lint	Grain sorghum	Wheat	Oats	Peanuts	Improved bermudagrass
	Lb	Bu	Bu	Bu	Lb	AUM*
1--- Abilene	325	40	25	45	---	5.0
2--- Abilene	300	35	25	45	---	4.5
3--- Bonti	---	35	---	35	---	4.0
4--- Bonti-Callahan-Exray	---	---	---	---	---	---
5--- Callahan	200	30	20	30	---	4.0
6--- Callahan	---	25	15	25	---	3.0
7--- Chaney	275	35	20	35	1,200	6.0
8--- Chaney	---	---	---	---	---	---
9--- Chaney Variant	275	35	20	35	1,200	6.0
10--- Cho	---	---	---	---	---	---
11--- Cisco	300	35	20	35	1,200	6.0
12--- Cisco	350	40	25	40	1,000	6.0
13--- Cisco	250	30	20	30	800	4.5
14:**						
Cisco---	250	30	20	30	800	4.5
Hext---	---	20	20	25	---	3.5
Pedernales---	---	25	20	30	700	3.5
15**--- Cisco-Hext-Pedernales	---	---	---	---	---	3.0
16--- Demona-Patilo	---	30	---	---	1,100	5.5
17--- Frio	400	55	30	50	---	6.0
18:**						
Frio---	---	---	---	---	---	6.0
Gageby---	---	---	---	---	---	6.0
19--- Gageby	350	45	30	50	1,000	6.0

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Cotton lint	Grain sorghum	Wheat	Oats	Peanuts	Improved bermudagrass
	Lb	Bu	Bu	Bu	Lb	AUM*
20:**						
Hext	---	---	---	---	---	---
Oplin	---	---	---	---	---	---
Brackett	---	---	---	---	---	---
21---Leeray	300	55	25	40	---	4.0
22---Leeray	250	45	25	40	---	4.0
23:**						
Lueders	---	---	---	---	---	---
Speck	---	---	---	---	---	---
24---Mereta	150	20	15	25	---	2.0
25---Nukrum	275	45	25	45	---	5.5
26---Nukrum	200	35	20	35	---	4.5
27---Nuvalde	250	35	20	50	---	4.5
28:**						
Oplin	---	---	---	---	---	---
Speck	---	---	---	---	---	---
29:**						
Owens	---	---	---	---	---	---
Throck	---	---	---	---	---	---
30---Pedernales	---	35	20	40	1,200	5.0
31---Pedernales	---	35	25	45	1,000	4.0
32---Pedernales	---	20	20	35	700	3.5
33.** Pits						
34---Rowden	250	35	20	40	---	4.0
35---Rowena	300	40	25	40	---	5.0
36---Rowena	250	35	25	40	---	4.5
37---Sagerton	300	40	25	45	---	5.0
38---Sagerton	250	35	20	40	---	4.5

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Cotton lint	Grain sorghum	Wheat	Oats	Peanuts	Improved bermudagrass
	Lb	Bu	Bu	Bu	Lb	AUM*
39---------- Speck	150	20	15	30	---	2.0
40:**						
Speck----------	---	---	---	---	---	---
Throck----------	---	---	---	---	---	---
41---------- Throck	150	25	15	35	---	3.0
42:**						
Throck----------	---	---	---	---	---	---
Callahan----------	---	---	---	---	---	---
Owens----------	---	---	---	---	---	---
43:**						
Throck----------	---	---	---	---	---	---
Owens----------	---	---	---	---	---	---
Lueders----------	---	---	---	---	---	---
44:**						
Throck----------	---	---	---	---	---	---
Speck----------	---	---	---	---	---	---

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded.
Absence of an entry indicates no acreage]

Class	Total Acreage	Major management concerns (subclass)			
		Erosion (e)	Wetness (w)	Soil problems (s)	Climate (c)
		Acres	Acres	Acres	Acres
I	---	---	---	---	---
II	104,980	76,730	19,330	---	8,920
III	134,420	132,020	360	2,040	---
IV	18,310	17,140	---	1,170	---
V	20,850	---	20,850	---	---
VI	154,430	46,630	---	107,800	---
VII	114,300	---	---	114,300	---

TABLE 7.--RANGELAND PRODUCTIVITY

[Only the soils that support rangeland vegetation are listed]

Map symbol and soil name	Range site name	Potential annual production for kind of growing season		
		Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
1, 2---- Abilene	Clay Loam----	4,500	3,500	2,500
3---- Bonti	Tight Sandy Loam----	4,000	3,000	2,500
4:*				
Bonti----	Tight Sandy Loam----	4,000	3,000	2,500
Callahan----	Claypan Prairie----	4,000	3,500	3,000
Exray----	Sandy Loam----	3,500	3,000	2,000
5, 6---- Callahan	Claypan Prairie----	4,000	3,000	2,000
7---- Chaney	Loamy Sand----	4,500	4,000	3,000
8---- Chaney	Sandy Loam----	4,500	4,000	3;000
9---- Chaney Variant	Loamy Sand----	4,500	4,000	3,000
10---- Cho	Very Shallow----	2,500	2,000	1,000
11---- Cisco	Loamy Sand----	4,500	4,000	3,000
12, 13---- Cisco	Sandy Loam----	4,500	4,000	3,000
14,* 15:*				
Cisco----	Sandy Loam----	5,000	4,000	3,000
Hext----	Sandy Loam----	4,000	3,000	2,000
Pedernales----	Tight Sandy Loam----	3,500	3,000	1,500
16:*				
Demona----	Sandy----	4,500	3,500	2,000
Patilo----	Deep Sand----	3,000	2,000	1,000
17---- Frio	Loamy Bottomland----	5,500	4,000	3,000
18:*				
Frio----	Loamy Bottomland----	5,500	4,000	3,000
Gageby----	Loamy Bottomland----	5,000	3,500	2,500
19---- Gageby	Loamy Bottomland----	5,000	3,500	2,500
20:*				
Hext----	Steep Adobe----	3,500	2,500	2,000
Oplin----	Steep Rocky----	1,700	1,300	900
Brackett----	Steep Adobe----	2,800	2,000	1,500

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY--Continued

Map symbol and soil name	Range site name	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
21, 22---------- Leeray	Clay Loam----------	4,500	3,500	2,500
23:*				
Lueders----------	Very Shallow----------	1,800	1,500	1,000
Speck----------	Redland----------	3,800	3,000	2,000
24---------- Mereta	Shallow----------	3,000	2,500	1,800
25, 26---------- Nukrum	Clay Loam----------	4,500	3,500	2,500
27---------- Nuvalde	Clay Loam----------	4,500	3,500	2,000
28:*				
Oplin----------	Low Stony Hills----------	2,000	1,500	1,000
Speck----------	Redland----------	3,800	3,000	2,000
29:*				
Owens----------	Rocky Hills----------	1,800	1,500	900
Throck----------	Rocky Hills----------	2,400	2,000	1,200
30---------- Pedernales	Loamy Sand----------	4,500	4,000	3,000
31, 32---------- Pedernales	Tight Sandy Loam----------	3,500	3,000	1,500
34---------- Rowden	Deep Redland----------	4,500	3,500	2,500
35, 36---------- Rowena	Clay Loam----------	4,500	3,500	2,500
37, 38---------- Sagerton	Clay Loam----------	4,500	3,500	2,500
39---------- Speck	Redland----------	3,800	3,000	2,000
40:*				
Speck----------	Redland----------	3,800	3,000	2,000
Throck----------	Shallow Clay----------	3,500	2,500	1,200
41---------- Throck	Shallow Clay----------	3,500	2,500	1,200
42:*				
Throck----------	Shallow Clay----------	3,500	2,500	1,200
Callahan----------	Claypan Prairie----------	4,000	3,000	2,000
Owens----------	Shallow Clay----------	3,000	2,000	1,500
43:*				
Throck----------	Rocky Hills----------	2,400	2,000	1,200
Owens----------	Rocky Hills----------	1,800	1,500	900
Lueders----------	Very Shallow----------	1,800	1,500	1,000

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY--Continued

Map symbol and soil name	Range site name	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
44:*				
Throck	Shallow Clay	3,500	2,500	1,200
Speck	Redland	3,800	3,000	2,000

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
1---------- Abilene	Slight----------	Slight----------	Slight----------	Slight.
2---------- Abilene	Slight----------	Slight----------	Moderate: slope.	Slight.
3---------- Bonti	Slight----------	Slight----------	Moderate: slope, depth to rock.	Severe: erodes easily.
4:*				
Bonti----------	Slight----------	Slight----------	Moderate: slope, depth to rock.	Severe: erodes easily, large stones.
Callahan----------	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, depth to rock.	Slight.
Exray----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: large stones.
5, 6---------- Callahan	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, depth to rock.	Slight.
7---------- Chaney	Slight----------	Slight----------	Moderate: slope.	Slight.
8---------- Chaney	Slight----------	Slight----------	Moderate: large stones, slope, small stones.	Slight.
9---------- Chaney Variant	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
10---------- Cho	Severe: cemented pan.	Severe: cemented pan.	Severe: small stones, cemented pan.	Slight.
11, 12, 13---------- Cisco	Slight----------	Slight----------	Moderate: slope.	Slight.
14,* 15:*				
Cisco----------	Slight----------	Slight----------	Moderate: slope.	Slight.
Hext----------	Slight----------	Slight----------	Moderate: slope, small stones, depth to rock.	Slight.
Pedernales----------	Slight----------	Slight----------	Moderate: slope.	Slight.
16:*				
Demona----------	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
Patilo----------	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
17--- Frio	Severe: floods.	Severe: too clayey.	Severe: too clayey.	Moderate: too clayey.
18:*				
Frio---	Severe: floods.	Severe: floods, too clayey.	Severe: too clayey, floods.	Moderate: too clayey, floods.
Gageby---	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
19--- Gageby	Severe: floods.	Slight---	Moderate: floods.	Slight.
20:*				
Hext---	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Oplin---	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: small stones.
Brackett---	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Moderate: slope.
21--- Leeray	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey, percs slowly.	Moderate: too clayey.
22--- Leeray	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.
23:*				
Lueders---	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Slight.
Speck---	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight.
24--- Mereta	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Slight.
25, 26--- Nukrum	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
27--- Nuvalde	Slight---	Slight---	Moderate: slope.	Slight.
28:*				
Oplin---	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: small stones.
Speck---	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, depth to rock.	Slight.
29:*				
Owens---	Severe: slope.	Severe: slope.	Severe: too clayey, slope.	Moderate: too clayey.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
29:* Throck	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: large stones, slope.
30, 31, 32--- Pedernales	Slight	Slight	Moderate: slope.	Slight.
33.* Pits				
34--- Rowden	Slight	Slight	Moderate: slope, depth to rock.	Slight.
35--- Rowena	Slight	Slight	Slight	Slight.
36--- Rowena	Slight	Slight	Moderate: slope.	Slight.
37--- Sagerton	Slight	Slight	Slight	Slight.
38--- Sagerton	Slight	Slight	Moderate: slope.	Slight.
39--- Speck	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight.
40:* Speck	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight.
Throck	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Moderate: large stones.
41--- Throck	Slight	Slight	Moderate: small stones, slope.	Slight.
42:* Throck	Slight	Slight	Moderate: small stones, slope.	Slight.
Callahan	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, depth to rock.	Slight.
Owens	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Severe: too clayey.	Moderate: too clayey.
43:* Throck	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: large stones, slope.
Owens	Severe: slope.	Severe: slope.	Severe: too clayey, slope.	Moderate: too clayey.
Lueders	Severe: small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: small stones, slope, depth to rock.	Moderate: slope.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
44:*				
Throck	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Moderate: large stones.
Speck	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
1, 2---------- Abilene	Good	Good	Fair	---	Good	Poor	Very poor	Good	Very poor.	Fair.
3---------- Bonti	Good	Good	Good	---	Good	Poor	Very poor	Good	Very poor.	Good.
4:*										
Bonti----------	Fair	Good	Good	---	Good	Poor	Very poor	Good	Very poor.	Good.
Callahan----------	Fair	Good	Fair	---	Fair	Poor	Very poor	Fair	Very poor.	Fair.
Exray----------	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor	Poor	Very poor.	Fair.
5, 6---------- Callahan	Fair	Good	Fair	---	Fair	Poor	Very poor	Fair	Very poor.	Fair.
7---------- Chaney	Fair	Good	Good	---	Good	Poor	Very poor	Good	Very poor.	Good.
8---------- Chaney	Poor	Poor	Good	---	Good	Poor	Very poor	Fair	Very poor.	Good.
9---------- Chaney Variant	Fair	Good	Good	---	Good	Poor	Poor	Good	Poor	Good.
10---------- Cho	Poor	Poor	Poor	---	Poor	Poor	Very poor	Poor	Very poor.	Poor.
11---------- Cisco	Fair	Good	Good	---	Good	Poor	Very poor	Good	Very poor.	Good.
12---------- Cisco	Good	Good	Good	---	Good	Poor	Very poor	Good	Very poor.	Good.
13---------- Cisco	Fair	Good	Good	---	Good	Poor	Very poor	Good	Very poor.	Good.
14:*										
Cisco----------	Fair	Good	Good	---	Good	Poor	Very poor	Good	Very poor.	Good.
Hext----------	Fair	Good	Good	---	Good	Poor	Very poor	Good	Very poor.	Good.
Pedernales--------	Fair	Good	Good	---	Good	Poor	Very poor	Good	Very poor.	Good.
15:*										
Cisco----------	Fair	Good	Good	---	Good	Poor	Very poor	Good	Very poor.	Good.
Hext----------	Poor	Fair	Good	---	Good	Poor	Very poor	Fair	Very poor.	Good.
Pedernales--------	Fair	Good	Good	---	Good	Poor	Very poor	Good	Very poor.	Good.
16:*										
Demona----------	Fair	Good	Good	---	Good	Poor	Very poor	Good	Very poor.	Good.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
16:*										
Patilo	Fair	Good	Fair	---	Fair	Poor	Very poor	Fair	Very poor.	Fair.
17 Frio	Good	Good	Fair	---	Good	Poor	Very poor	Good	Very poor.	Fair.
18:*										
Frio	Very poor.	Poor	Fair	---	Good	Poor	Very poor	Poor	Very poor.	Fair.
Gageby	Very poor.	Poor	Fair	---	Good	Very poor.	Very poor	Poor	Very poor.	Fair.
19 Gageby	Good	Good	Good	---	Good	Very poor.	Very poor	Good	Very poor.	Good.
20:*										
Hext.										
Oplin	Very poor.	Very poor.	Fair	---	Fair	Very poor.	Very poor	Poor	Very poor.	Fair.
Brackett	Very poor.	Very poor.	Fair	---	Fair	Very poor.	Very poor	Very poor.	Very poor.	Fair.
21, 22 Leeray	Fair	Fair	Fair	---	Fair	Poor	Very poor	Fair	Very poor.	Fair.
23:*										
Lueders	Very poor.	Very poor.	Fair	---	Fair	Very poor.	Very poor	Poor	Very poor.	Fair.
Speck	Fair	Fair	Fair	---	Fair	Very poor.	Very poor	Fair	Very poor.	Fair.
24 Mereta	Fair	Fair	Fair	---	Fair	Poor	Very poor	Fair	Very poor.	Fair.
25 Nukrum	Good	Good	Fair	---	Fair	Poor	Very poor	Good	Very poor.	Fair.
26 Nukrum	Fair	Good	Fair	---	Fair	Poor	Very poor	Fair	Very poor.	Fair.
27 Nuvalde	Good	Good	Fair	---	Fair	Poor	Very poor	Good	Very poor.	Fair.
28:*										
Oplin	Very poor.	Very poor.	Fair	---	Fair	Very poor.	Very poor	Poor	Very poor.	Fair.
Speck	Poor	Poor	Fair	---	Good	Very poor.	Very poor	Poor	Very poor.	Fair.
29:*										
Owens	Very poor.	Very poor.	Fair	---	Fair	Very poor.	Very poor	Very poor.	Very poor.	Poor.
Throck	Very poor.	Very poor.	Fair	---	Fair	Very poor.	Very poor	Poor	Very poor.	Fair.
30 Pedernales	Fair	Good	Good	---	Good	Poor	Very poor	Good	Very poor.	Good.
31 Pedernales	Good	Good	Good	---	Good	Poor	Very poor	Good	Very poor.	Good.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
32---------- Pedernales	Fair	Good	Good	---	Good	Poor	Very poor	Good	Very poor.	Good.
33.* Pits										
34---------- Rowden	Fair	Good	Good	---	Good	Very poor.	Very poor.	Good	Very poor.	Good,
35, 36---------- Rowena	Good	Good	Fair	---	Fair	Poor	Very poor	Good	Very poor.	Fair.
37, 38---------- Sagerton	Good	Good	Fair	---	Good	Very poor.	Very poor	Good	Very poor.	Fair.
39---------- Speck	Fair	Fair	Fair	---	Fair	Very poor.	Very poor	Fair	Very poor.	Fair.
40:*										
Speck----------	Poor	Poor	Fair	---	Good	Very poor.	Very poor	Poor	Very poor.	Fair.
Throck----------	Poor	Poor	Fair	---	Fair	Poor	Very poor	Poor	Very poor.	Fair.
41---------- Throck	Fair	Good	Fair	---	Fair	Poor	Very poor	Fair	Very poor.	Fair.
42:*										
Throck----------	Fair	Good	Fair	---	Fair	Poor	Very poor	Fair	Very poor.	Fair.
Callahan----------	Fair	Good	Fair	---	Fair	Poor	Very poor	Fair	Very poor.	Fair.
Owens----------	Fair	Fair	Fair	---	Poor	Very poor.	Very poor	Fair	Very poor.	Poor.
43:*										
Throck----------	Very poor.	Very poor.	Fair	---	Fair	Very poor.	Very poor	Poor	Very poor.	Fair.
Owens----------	Very poor.	Very poor.	Fair	---	Fair	Very poor.	Very poor	Very poor.	Very poor.	Poor.
Lueders----------	Very poor.	Very poor.	Fair	---	Fair	Very poor.	Very poor	Poor	Very poor.	Fair.
44:*										
Throck----------	Poor	Poor	Fair	---	Fair	Poor	Very poor	Poor	Very poor.	Fair.
Speck----------	Poor	Poor	Fair	---	Good	Very poor.	Very poor	Poor	Very poor.	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1, 2--Abilene	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
3--Bonti	Severe: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: thin layer.
4:*						
Bonti	Severe: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Moderate: thin layer.
Callahan	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Moderate: thin layer.
Exray	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, low strength.	Severe: thin layer.
5, 6--Callahan	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: thin layer.
7--Chaney	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
8--Chaney	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Moderate: large stones.
9--Chaney Variant	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding.	Severe: ponding.
10--Cho	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Moderate: cemented pan.	Severe: thin layer.
11, 12, 13--Cisco	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.	Slight.
14:*						
Cisco	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.	Slight.
Hext	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Slight	Slight	Moderate: thin layer.
Pedernales	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
15:*						
Cisco	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, shrink-swell.	Slight.
Hext	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Slight	Moderate: thin layer.
Pedernales	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
16:*						
Demona	Severe: cutbanks cave, wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength.	Moderate: wetness, droughty.
Patilo	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Slight	Moderate: droughty.
17 Frio	Moderate: too clayey, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.	Severe: too clayey.
18:*						
Frio	Moderate: too clayey, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.	Severe: floods, too clayey.
Gageby	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.	Severe: floods.
19 Gageby	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.	Moderate: floods.
20:*						
Hext	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Oplin	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: large stones, slope, thin layer.
Brackett	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope, thin layer.
21, 22 Leeray	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
23:*						
Lueders	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, thin layer.
Speck	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, low strength, shrink-swell.	Severe: thin layer.
24 Mereta	Severe: cemented pan.	Moderate: shrink-swell, cemented pan.	Severe: cemented pan.	Moderate: shrink-swell, cemented pan.	Severe: low strength.	Severe: thin layer.
25, 26 Nukrum	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
27 Nuvalde	Slight	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
28:*						
Oplin	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, thin layer.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
28:*						
Speck	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, low strength, shrink-swell.	Severe: thin layer.
29:*						
Owens	Severe: slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope, low strength.	Severe: too clayey, slope.
Throck	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
30, 31, 32--------- Pedernales	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
33.* Pits						
34---------- Rowden	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Moderate: thin layer.
35, 36---------- Rowena	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
37, 38---------- Sagerton	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
39---------- Speck	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, low strength, shrink-swell.	Severe: thin layer.
40:*						
Speck	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, low strength, shrink-swell.	Severe: thin layer.
Throck	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: large stones.
41---------- Throck	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
42:*						
Throck	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
Callahan	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Moderate: thin layer.
Owens	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
43:*						
Throck	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
43:*						
Owens	Severe: slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope, low strength.	Severe: too clayey, slope.
Lueders	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: small stones, slope, thin layer.
44:*						
Throck	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Moderate: large stones.
Speck	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, low strength, shrink-swell.	Severe: thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," and other terms. Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1--Abilene	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
2--Abilene	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
3--Bonti	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey.
4:*					
Bonti	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey.
Callahan	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey.
Exray	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, large stones.
5, 6--Callahan	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey.
7--Chaney	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
8--Chaney	Severe: percs slowly.	Moderate: slope, seepage.	Severe: too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.
9--Chaney Variant	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: hard to pack, ponding.
10--Cho	Severe: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Poor: area reclaim.
11, 12, 13--Cisco	Slight	Severe: seepage.	Severe: seepage.	Slight	Good.
14,* 15:*					
Cisco	Slight	Severe: seepage.	Severe: seepage.	Slight	Good.
Hext	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Pedernales	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
16:*					
Demona	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness, too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
16:*					
Patilo	Severe: percs slowly, poor filter.	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
17					
Frio	Severe: floods, percs slowly.	Slight	Severe: floods, too clayey.	Severe: floods.	Poor: too clayey, hard to pack.
18:*					
Frio	Severe: floods, percs slowly.	Severe: floods.	Severe: floods, too clayey.	Severe: floods.	Poor: too clayey, hard to pack.
Gageby	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
19					
Gageby	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
20:*					
Hext	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
Oplin	Severe: depth to rock, slope.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.
Brackett	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.
21					
Leeray	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
22					
Leeray	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
23:*					
Lueders	Severe: depth to rock.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, small stones.
Speck	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
24					
Mereta	Severe: cemented pan.	Severe: cemented pan.	Moderate: cemented pan, too clayey.	Moderate: cemented pan.	Poor: area reclaim, hard to pack.
25, 26					
Nukrum	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
27					
Nuvalde	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey, hard to pack.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
28:*					
Oplin	Severe: depth to rock.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, small stones.
Speck	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
29:*					
Owens	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: slope, too clayey, hard to pack.
Throck	Severe: percs slowly, slope.	Severe: slope.	Severe: depth to rock, slope, too clayey.	Severe: slope.	Poor: area reclaim, too clayey, slope.
30--- Pedernales	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.
31, 32--- Pedernales	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
33.* Pits					
34--- Rowden	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
35--- Rowena	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
36--- Rowena	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
37--- Sagerton	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey.
38--- Sagerton	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
39--- Speck	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
40:*					
Speck	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Throck	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: area reclaim, too clayey.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
41---------- Throck	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: area reclaim, too clayey.
42:*					
Throck----------	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: area reclaim, too clayey.
Callahan----------	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey.
Owens----------	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight----------	Poor: too clayey, hard to pack.
43:*					
Throck----------	Severe: percs slowly, slope.	Severe: slope.	Severe: depth to rock, slope, too clayey.	Severe: slope.	Poor: area reclaim, too clayey, slope.
Owens----------	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: slope, too clayey, hard to pack.
Lueders----------	Severe: depth to rock, slope.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.
44:*					
Throck----------	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: area reclaim, too clayey.
Speck----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1, 2---------- Abilene	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
3---------- Bonti	Poor: low strength, area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
4:*				
Bonti----------	Poor: low strength, area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Callahan----------	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Exray----------	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
5, 6---------- Callahan	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
7---------- Chaney	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
8---------- Chaney	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
9---------- Chaney Variant	Poor: low strength, ponding.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
10---------- Cho	Good----------	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
11---------- Cisco	Good----------	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, thin layer.
12, 13---------- Cisco	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
14,* 15:*				
Cisco----------	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
Hext----------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Pedernales----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
16:*				
Demona----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
Patilo----------	Good----------	Probable----------	Improbable: too sandy.	Poor: too sandy.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
17--- Frio	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
18:*				
Frio---	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Gageby---	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
19--- Gageby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
20:*				
Hext---	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Oplin---	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones, slope.
Brackett---	Poor: area reclaim, low strength, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
21, 22--- Leeray	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
23:*				
Lueders---	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
Speck---	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
24--- Mereta	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
25, 26--- Nukrum	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
27--- Nuvalde	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
28:*				
Oplin---	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
Speck---	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
29:*				
Owens---	Poor: low strength, slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope, area reclaim, too clayey.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
29:*				
Throck	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
30, 31, 32--Pedernales	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
33.* Pits				
34--Rowden	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey.
35, 36--Rowena	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
37, 38--Sagerton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
39--Speck	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
40:*				
Speck	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
Throck	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
41--Throck	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
42:*				
Throck	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Callahan	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Owens	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey.
43:*				
Throck	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Owens	Poor: low strength, slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope, area reclaim, too clayey.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
43:* Lueders	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
44:* Throck	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Speck	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Map symbol and soil name	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1, 2---------- Abilene	Slight---------	Moderate: hard to pack.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
3---------- Bonti	Moderate: depth to rock.	Severe: thin layer.	Deep to water	Soil blowing, depth to rock.	Depth to rock, erodes easily, soil blowing.	Erodes easily, depth to rock.
4:*						
Bonti----------	Moderate: depth to rock, slope.	Severe: thin layer.	Deep to water	Soil blowing, depth to rock.	Depth to rock, erodes easily, soil blowing.	Erodes easily, depth to rock.
Callahan---------	Moderate: depth to rock, slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
Exray----------	Severe: depth to rock.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
5---------- Callahan	Moderate: depth to rock.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
6---------- Callahan	Moderate: depth to rock, slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
7---------- Chaney	Slight---------	Severe: hard to pack.	Deep to water	Fast intake, soil blowing, percs slowly.	Soil blowing, percs slowly.	Percs slowly, rooting depth.
8---------- Chaney	Slight---------	Severe: hard to pack.	Deep to water	Fast intake----	Percs slowly---	Percs slowly.
9---------- Chaney Variant	Slight---------	Severe: seepage, ponding.	Ponding, percs slowly.	Ponding, fast intake, soil blowing.	Ponding, soil blowing, percs slowly.	Wetness, percs slowly.
10---------- Cho	Severe: cemented pan, seepage.	Severe: thin layer.	Deep to water	Cemented pan, slope.	Cemented pan---	Droughty, cemented pan.
11---------- Cisco	Moderate: seepage.	Moderate: piping.	Deep to water	Fast intake, soil blowing.	Favorable------	Favorable.
12, 13---------- Cisco	Moderate: seepage.	Moderate: piping.	Deep to water	Soil blowing---	Erodes easily	Erodes easily.
14,* 15:*						
Cisco----------	Moderate: seepage.	Moderate: piping.	Deep to water	Soil blowing---	Erodes easily	Erodes easily.
Hext----------	Moderate: seepage, depth to rock.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Depth to rock, soil blowing.	Depth to rock.
Pedernales-------	Slight---------	Moderate: hard to pack.	Deep to water	Soil blowing, slope.	Soil blowing---	Favorable.
16:*						
Demona----------	Severe: seepage.	Moderate: hard to pack, wetness.	Slope, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, soil blowing.	Droughty.
Patilo----------	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
17---------- Frio	Slight---------	Moderate: hard to pack.	Deep to water	Slow intake, floods.	Favorable------	Favorable.
18:*						
Frio----------	Slight---------	Moderate: hard to pack.	Deep to water	Slow intake, floods.	Favorable------	Favorable.
Gageby----------	Moderate: seepage.	Moderate: piping.	Deep to water	Floods---------	Favorable------	Favorable.
19---------- Gageby	Moderate: seepage.	Moderate: piping.	Deep to water	Floods---------	Favorable------	Favorable.
20:*						
Hext----------	Moderate: seepage, depth to rock.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Slope, depth to rock, soil blowing.	Slope, depth to rock.
Oplin----------	Severe: depth to rock, slope.	Severe: thin layer, large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Brackett---------	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Large stones, slope, depth to rock.	Large stones, slope, depth to rock.
21, 22---------- Leeray	Slight---------	Severe: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly---	Percs slowly.
23:*						
Lueders----------	Severe: depth to rock.	Severe: thin layer, large stones.	Deep to water	Large stones, droughty, depth to rock.	Large stones, depth to rock.	Large stones, droughty, depth to rock.
Speck----------	Severe: depth to rock.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
24---------- Mereta	Severe: cemented pan, seepage.	Severe: thin layer.	Deep to water	Cemented pan---	Cemented pan---	Cemented pan.
25---------- Nukrum	Slight---------	Moderate: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly---	Percs slowly.
26---------- Nukrum	Slight---------	Moderate: hard to pack.	Deep to water	Slow intake, percs slowly, slope.	Percs slowly---	Percs slowly.
27---------- Nuvalde	Severe: seepage.	Moderate: piping.	Deep to water	Favorable------	Favorable------	Favorable.
28:*						
Oplin----------	Severe: depth to rock.	Severe: thin layer, large stones.	Deep to water	Large stones, droughty, depth to rock.	Large stones, depth to rock.	Large stones, droughty, depth to rock.
Speck----------	Severe: depth to rock.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Large stones, depth to rock, percs slowly.	Large stones, depth to rock, percs slowly.
29:*						
Owens----------	Severe: slope.	Moderate: hard to pack.	Deep to water	Slope, droughty, slow intake.	Erodes easily, slope.	Slope, droughty, erodes easily.
Throck----------	Severe: slope.	Slight---------	Deep to water	Percs slowly, slope.	Slope, percs slowly.	Slope, percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
30---------- Pedernales	Slight---------	Moderate: hard to pack.	Deep to water	Fast intake, soil blowing.	Soil blowing---	Favorable.
31, 32---------- Pedernales	Slight---------	Moderate: hard to pack.	Deep to water	Soil blowing---	Soil blowing---	Favorable.
33.* Pits						
34---------- Rowden	Moderate: depth to rock.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
35, 36---------- Rowena	Slight---------	Moderate: hard to pack.	Deep to water	Favorable------	Favorable------	Favorable.
37, 38---------- Sagerton	Slight---------	Moderate: piping.	Deep to water	Favorable------	Favorable------	Favorable.
39---------- Speck	Severe: depth to rock.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
40:*						
Speck----------	Severe: depth to rock.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Large stones, depth to rock, percs slowly.	Large stones, depth to rock, percs slowly.
Throck----------	Moderate: depth to rock.	Slight---------	Deep to water	Percs slowly, slope.	Percs slowly---	Percs slowly.
41---------- Throck	Moderate: depth to rock.	Slight---------	Deep to water	Percs slowly, slope.	Percs slowly---	Percs slowly.
42:*						
Throck----------	Moderate: depth to rock.	Slight---------	Deep to water	Percs slowly, slope.	Percs slowly---	Percs slowly.
Callahan---------	Moderate: depth to rock, slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
Owens----------	Moderate: slope.	Moderate: hard to pack.	Deep to water	Slope, droughty, slow intake.	Erodes easily, percs slowly.	Droughty, erodes easily.
43:*						
Throck----------	Moderate: depth to rock.	Slight---------	Deep to water	Percs slowly, slope.	Slope, percs slowly.	Slope, percs slowly.
Owens----------	Severe: slope.	Moderate: hard to pack.	Deep to water	Slope, droughty, slow intake.	Erodes easily, slope.	Slope, droughty, erodes easily.
Lueders----------	Severe: depth to rock.	Severe: thin layer, large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
44:*						
Throck----------	Moderate: depth to rock.	Slight---------	Deep to water	Percs slowly, slope.	Percs slowly---	Percs slowly.
Speck----------	Severe: depth to rock.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Large stones, depth to rock, percs slowly.	Large stones, depth to rock, percs slowly.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Map symbol and soil name	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1, 2---------- Abilene	0-9	Loam----------	CL	A-4, A-6	0	95-100	95-100	90-100	60-96	25-35	8-16
	9-32	Clay loam, silty clay loam, clay.	CL, CH	A-7, A-6	0	95-100	95-100	90-100	75-95	34-58	22-40
	32-80	Clay loam, clay, silty clay loam.	CL	A-6, A-7	0	90-100	88-100	80-98	60-95	35-50	19-32
3---------- Bonti	0-8	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-4, A-2-4	0-2	90-100	90-100	70-100	25-70	18-30	2-7
	8-30	Clay, clay loam, sandy clay.	CL	A-6, A-7	0-4	80-100	80-100	70-100	51-75	30-45	18-25
	30-35	Weathered bedrock	---	---	---	---	---	---	---	---	---
4:*											
Bonti----------	0-8	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-4, A-2-4	0-2	90-100	90-100	70-100	25-70	18-30	2-7
	8-25	Clay, clay loam, sandy clay.	CL	A-6, A-7	0-4	80-100	80-100	70-100	51-75	30-45	18-25
	25-35	Weathered bedrock	---	---	---	---	---	---	---	---	---
Callahan--------	0-5	Loam----------	CL, CL-ML, SC, SM-SC	A-4, A-6	0	85-100	85-100	75-100	45-80	25-35	7-16
	5-26	Clay, clay loam	CL	A-6, A-7-6	0	90-100	90-100	80-100	60-95	35-50	19-30
	26-45	Shaly clay, weathered bedrock.	---	---	---	---	---	---	---	---	---
Exray----------	0-6	Stony fine sandy loam.	SM-SC, SC	A-2-4, A-4	5-23	85-100	80-100	55-80	30-50	20-30	5-10
	6-15	Clay, sandy clay, clay loam.	CL, SC	A-6, A-7	0-5	85-100	80-100	80-100	48-80	30-45	15-25
	15-35	Weathered bedrock	---	---	---	---	---	---	---	---	---
5, 6---------- Callahan	0-4	Loam----------	CL, CL-ML, SC, SM-SC	A-4, A-6	0	85-100	85-100	75-100	45-80	25-35	7-16
	4-38	Clay, clay loam	CL	A-6, A-7-6	0	90-100	90-100	80-100	60-95	35-50	19-30
	38-45	Shaly clay, weathered bedrock.	---	---	---	---	---	---	---	---	---
7---------- Chaney	0-14	Loamy fine sand	SM, SM-SC, SP-SM	A-2-4, A-4, A-3	0	80-100	80-100	65-98	7-45	<25	NP-4
	14-45	Clay, sandy clay	CL, CH	A-7-6	0	90-100	90-100	90-100	43-85	39-60	24-42
	45-72	Sandy clay, clay, sandy clay loam.	CL, CH, SC	A-6, A-7-6, A-2-6, A-2-7	0	90-100	90-100	80-100	30-70	25-55	11-40
8---------- Chaney	0-8	Stony sandy loam	SM, SM-SC, SP-SM	A-2-4, A-4, A-3	5-25	80-100	80-100	65-98	7-45	<25	NP-4
	8-41	Clay, sandy clay	CL, CH	A-7	0-15	90-100	90-100	90-100	51-85	42-60	24-42
	41-70	Sandy clay, clay, sandy clay loam.	CL, CH, SC	A-6, A-7-6, A-2-6, A-2-7	0	90-100	90-100	80-100	30-70	25-55	11-40
9---------- Chaney Variant	0-18	Loamy fine sand	SM, SM-SC, SP-SM	A-2-4, A-4, A-3	0	80-100	80-100	65-98	7-45	<25	NP-4
	18-50	Sandy clay, clay.	CL, CH	A-7-6	0	90-100	90-100	90-100	43-85	39-60	24-42
	50-65	Sandy clay-------	CL, CH, SC	A-6, A-7-6, A-2-6	0	90-100	90-100	80-100	30-70	25-55	11-40
10---------- Cho	0-10	Gravelly loam----	CL	A-4, A-6	0-5	60-95	55-95	55-80	51-70	25-40	8-20
	10-15	Cemented---------	---	---	---	---	---	---	---	---	---
	15-50	Variable---------	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
11---------- Cisco	0-10	Loamy fine sand	SM, SM-SC	A-4, A-2-4	0	95-100	95-100	80-100	15-45	<25	NP-4
	10-51	Sandy clay loam, clay loam.	SC, CL	A-6	0	95-100	95-100	85-100	40-60	25-40	11-25
	51-65	Sandy clay loam, fine sandy loam.	SC, CL	A-4, A-6	0	95-100	95-100	85-95	40-60	20-35	8-20
12, 13---------- Cisco	0-9	Fine sandy loam	SM, SM-SC, CL-ML, ML	A-4	0	95-100	95-100	90-100	40-55	<26	NP-7
	9-49	Sandy clay loam, clay loam.	SC, CL	A-6	0	95-100	95-100	85-100	40-60	25-40	11-25
	49-65	Sandy clay loam, fine sandy loam.	SC, CL	A-4, A-6	0	95-100	95-100	85-95	40-60	20-35	8-20
14,* 15:*											
Cisco----------	0-6	Fine sandy loam	SM, SM-SC, CL-ML, ML	A-4	0	95-100	95-100	90-100	40-55	<26	NP-7
	6-43	Sandy clay loam, clay loam.	SC, CL	A-6	0	95-100	95-100	85-100	40-60	25-40	11-25
	43-50	Sandy clay loam, fine sandy loam.	SC, CL	A-4, A-6	0	95-100	95-100	85-95	40-60	20-35	8-20
Hext----------	0-6	Loam----------	SM, SM-SC, SC, CL-ML	A-4	0-2	85-100	80-100	60-90	40-70	<25	NP-8
	6-28	Fine sandy loam, loam, sandy clay loam.	CL, SC, SM-SC, CL-ML	A-4, A-2-4	0-2	75-100	70-100	50-90	30-70	<30	NP-10
	28-35	Weathered bedrock	---	---	---	---	---	---	---	---	---
Pedernales------	0-7	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4, A-2-4	0	95-100	90-100	75-100	33-55	<25	NP-7
	7-38	Sandy clay, clay	CH, CL, SC	A-7, A-6	0	90-100	90-100	85-100	45-75	38-60	20-36
	38-45	Sandy clay loam, clay loam, sandy clay.	SC, CL, CH	A-6, A-7	0-5	90-100	90-100	80-100	36-75	32-55	13-30
16:*											
Demona----------	0-25	Fine sand--------	SM, SP-SM, SM-SC	A-2-4, A-4, A-3	0	80-100	70-100	65-98	7-45	<25	NP-5
	25-61	Sandy clay, clay	CH, CL, SC	A-7-6	0	80-100	80-100	80-100	41-85	33-60	20-40
	61-70	Sandy clay, clay, sandy clay loam.	CL, CH, SC	A-2-6, A-7-6, A-6	0	80-100	80-100	80-100	25-85	25-60	11-40
Patilo----------	0-58	Fine sand--------	SM, SP-SM, SM-SC	A-2-4, A-3	0	100	95-100	85-100	5-28	<25	NP-5
	58-80	Sandy clay loam, fine sandy loam.	SC	A-2, A-4, A-6	0	90-100	90-100	90-100	25-50	22-36	8-20
17---------- Frio	0-27	Clay loam--------	CL, CH	A-6, A-7	0-2	80-100	80-100	70-100	60-95	35-52	20-34
	27-70	Silty clay loam, clay loam, silty clay loam.	CL, CH	A-6, A-7	0-5	80-100	80-100	70-100	60-95	30-52	18-34
18:*											
Frio----------	0-24	Clay loam--------	CL, CH	A-6, A-7	0-2	80-100	80-100	70-100	60-95	35-52	20-34
	24-50	Silty clay loam, clay loam, silty clay loam.	CL, CH	A-6, A-7	0-5	80-100	80-100	70-100	60-95	30-52	18-34
Gageby----------	0-60	Loam, sandy clay loam.	CL	A-4, A-6	0	100	95-100	85-100	51-90	25-40	8-24
19---------- Gageby	0-60	Loam----------	CL	A-4, A-6	0	100	95-100	85-100	51-90	25-40	8-24

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
20:*											
Hext	0-7	Loam	SM, SM-SC, SC, CL-ML	A-4	0-2	85-100	80-100	60-90	40-70	<25	NP-8
	7-24	Fine sandy loam, loam, sandy clay loam.	CL, SC, SM-SC, CL-ML	A-4, A-2-4	0-2	75-100	70-100	50-90	30-70	<30	NP-10
	24-35	Weathered bedrock	---	---	---	---	---	---	---	---	---
Oplin	0-17	Very cobbly clay loam.	CL, GC, SC	A-2, A-4, A-6, A-7	15-45	40-75	35-75	30-65	25-60	25-47	8-25
	17-65	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Brackett	0-13	Gravelly loam	CL, SC, GC	A-6, A-4, A-7-6	0-20	70-100	60-100	54-95	40-85	28-40	9-20
	13-20	Weathered bedrock	---	---	---	---	---	---	---	---	---
21, 22	0-43	Clay	CH	A-7-6	0-5	95-100	95-100	85-100	75-95	51-70	30-45
Leeray	43-65	Clay, silty clay	CH, CL	A-7-6, A-6	0-5	95-100	95-100	85-100	70-95	33-60	19-40
23:*											
Lueders	0-8	Cobbly clay loam	CL, GC, SC	A-2, A-4, A-6, A-7	15-40	40-75	35-70	30-65	25-60	25-47	8-25
	8-14	Very cobbly loam, very cobbly clay loam, very gravelly clay loam.	CL, GC, SC	A-2, A-4, A-6, A-7	25-50	40-75	35-70	30-65	25-60	25-47	8-25
	14-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Speck	0-5	Clay loam	CL	A-6, A-7-6	0	90-100	90-100	80-95	70-90	30-45	15-25
	5-15	Clay, clay loam	CL, CH	A-7-6	0	85-100	80-100	70-100	55-95	45-65	25-40
	15-22	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---
24	0-16	Clay loam	CL, CH	A-6, A-7-6	0-5	90-100	83-100	80-97	60-85	39-52	19-30
Mereta	16-22	Variable, cemented.	---	---	---	---	---	---	---	---	---
	22-60	Variable, marl	---	---	---	---	---	---	---	---	---
25, 26	0-39	Clay	CL, CH	A-7-6	0	95-100	90-100	90-100	78-95	41-55	25-36
Nukrum	39-65	Silty clay, clay, clay loam.	CL, CH	A-7-6	0	95-100	90-100	90-100	70-95	45-60	27-40
	65-70	Silty clay, clay loam, silty clay loam.	CL, CH	A-7-6	0	85-100	75-100	70-95	65-95	41-55	25-35
27	0-15	Clay loam	CL	A-7-6, A-6	0	95-100	95-100	90-100	85-96	35-50	15-27
Nuvalde	15-49	Clay loam, silty clay loam.	CL	A-7-6, A-6	0	95-100	95-100	90-100	70-98	35-50	15-27
	49-60	Clay loam, silty clay loam.	CL	A-6, A-7-6	0	85-100	80-100	70-98	65-98	30-45	11-23
28:*											
Oplin	0-6	Very flaggy clay loam.	CL, GC, SC	A-2, A-4, A-6, A-7	15-45	40-75	35-75	30-65	25-60	25-47	8-25
	6-30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
28:*											
Speck	0-6	Cobbly clay loam	CL	A-6, A-7-6	5-25	80-100	80-100	80-95	70-90	30-45	15-25
	6-18	Clay, clay loam, cobbly clay.	CL, CH	A-7-6	0-25	85-100	80-100	70-100	55-95	45-65	25-40
	18-22	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---
29:*											
Owens	0-3	Stony clay	CL, CH	A-7-6	5-15	85-100	80-100	75-100	70-95	45-60	22-32
	3-17	Clay, clay loam, silty clay.	CL, CH	A-7-6	0-10	90-100	85-100	80-100	75-95	45-60	22-32
	17-30	Weathered bedrock, very shaly clay, shaly clay.	CL, CH	A-7-6	0-10	90-100	85-100	80-100	55-95	40-55	25-35
Throck	0-4	Stony clay loam	CL	A-6, A-7	5-30	70-90	70-90	60-90	50-85	30-45	18-28
	4-24	Gravelly clay, gravelly silty clay, clay.	CL, SC, GC	A-6, A-7	0-5	55-99	55-99	50-99	40-90	35-48	20-30
	24-42	Clay, silty clay loam, shaly clay.	CL	A-6, A-7	0	95-100	95-100	90-100	75-95	30-50	14-30
30	0-12	Loamy fine sand	SM	A-2-4	0	95-100	90-100	75-95	15-33	<25	NP-3
Pedernales	12-40	Sandy clay, clay	CH, CL, SC	A-7, A-6	0	90-100	90-100	85-100	45-75	38-60	20-36
	40-70	Sandy clay loam, clay loam, sandy clay.	SC, CL, CH	A-6, A-7	0-5	90-100	90-100	80-100	36-75	32-55	13-30
31, 32	0-6	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4, A-2-4	0	95-100	90-100	75-100	33-55	<25	NP-7
Pedernales	6-30	Sandy clay, clay	CH, CL, SC	A-7, A-6	0	90-100	90-100	85-100	45-75	38-60	20-36
	30-70	Sandy clay loam, clay loam, sandy clay.	SC, CL, CH	A-6, A-7	0-5	90-100	90-100	80-100	36-75	32-55	13-30
33.*											
Pits											
34	0-8	Clay loam	CL	A-6, A-7-6	0-5	90-100	90-100	80-100	55-80	30-45	15-25
Rowden	8-27	Clay, clay loam	CH, CL	A-7-6	0-5	85-100	80-100	75-100	55-85	41-60	20-35
	27-32	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
35, 36	0-6	Clay loam	CL	A-6, A-7	0	95-100	90-100	85-100	70-85	35-50	15-30
Rowena	6-46	Clay, clay loam	CH, CL	A-7	0	95-100	95-100	90-100	75-95	41-55	25-35
	46-60	Clay, clay loam, silty clay loam.	CH, CL	A-6, A-7	0	85-100	75-100	65-90	55-85	32-55	14-28
37, 38	0-7	Loam	CL	A-6, A-4	0	95-100	95-100	90-100	55-80	25-35	8-18
Sagerton	7-40	Clay loam, clay	CL	A-6, A-7-6	0	95-100	95-100	90-100	65-95	36-50	18-30
	40-65	Clay loam, clay	CL	A-6, A-4	0	90-100	90-100	80-100	60-85	25-40	8-22
39	0-7	Clay loam	CL	A-6, A-7-6	0	90-100	90-100	80-97	70-90	30-45	15-25
Speck	7-18	Clay, clay loam	CL, CH	A-7-6	0	85-100	80-100	70-100	55-95	45-65	25-40
	18-22	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
40:*											
Speck	0-6	Stony clay loam	CL	A-6, A-7-6	5-25	80-100	80-100	80-95	70-90	30-45	15-25
	6-18	Clay, clay loam, cobbly clay.	CL, CH	A-7-6	0-25	85-100	80-100	70-100	55-95	45-65	25-40
	18-22	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---
Throck	0-7	Stony clay loam	CL	A-6, A-7	5-30	70-90	70-90	60-90	50-85	30-45	18-28
	7-29	Gravelly clay, gravelly silty clay, clay.	CL, SC, GC	A-6, A-7	0-5	55-99	55-99	50-99	40-90	35-48	20-30
	29-45	Clay, silty clay loam, shaly clay.	CL	A-6, A-7	0	95-100	95-100	90-100	75-95	30-50	14-30
41	0-6	Clay loam	CL	A-6, A-7	0-2	80-100	80-99	75-99	60-90	30-45	18-28
Throck	6-34	Silty clay, silty clay loam, clay.	CL	A-6, A-7	0-2	80-99	80-99	75-99	60-90	35-48	20-30
	34-40	Clay, silty clay, shaly clay.	CL	A-6, A-7	0	95-100	95-100	90-100	75-95	30-50	14-30
42:*											
Throck	0-6	Clay loam	CL	A-6, A-7	0-2	80-100	80-99	75-99	60-90	30-45	18-28
	6-28	Silty clay, silty clay loam, clay.	CL	A-6, A-7	0-2	80-99	80-99	75-99	60-90	35-48	20-30
	28-42	Clay, silty clay, shaly clay.	CL	A-6, A-7	0	95-100	95-100	90-100	75-95	30-50	14-30
Callahan	0-6	Clay loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0	85-100	85-100	75-100	45-80	25-35	7-16
	6-35	Clay, clay loam	CL	A-6, A-7-6	0	90-100	90-100	80-100	60-95	35-50	19-30
	35-45	Shaly clay, weathered bedrock.	---	---	---	---	---	---	---	---	---
Owens	0-4	Clay	CL, CH	A-7-6	0-5	95-100	95-100	85-100	75-95	45-60	22-32
	4-18	Clay, clay loam, silty clay.	CL, CH	A-7-6	0-5	95-100	90-100	85-100	75-95	45-60	22-32
	18-30	Weathered bedrock, very shaly clay, shaly clay.	CL, CH	A-7-6	0-5	90-100	85-100	80-100	55-95	40-55	25-35
43:*											
Throck	0-5	Stony clay loam	CL	A-6, A-7	5-30	70-90	70-90	60-90	50-85	30-45	18-28
	5-31	Gravelly clay, gravelly silty clay, clay.	CL, SC, GC	A-6, A-7	0-5	55-99	55-99	50-99	40-90	35-48	20-30
	31-42	Clay, silty clay loam, shaly clay.	CL	A-6, A-7	0	95-100	95-100	90-100	75-95	30-50	14-30
Owens	0-4	Stony clay	CL, CH	A-7-6	5-15	85-100	80-100	75-100	70-95	45-60	22-32
	4-17	Clay, clay loam, silty clay.	CL, CH	A-7-6	0-10	90-100	85-100	80-100	75-95	45-60	22-32
	17-30	Weathered bedrock, very shaly clay, shaly clay.	CL, CH	A-7-6	0-10	90-100	85-100	80-100	55-95	40-55	25-35

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
43:*											
Lueders----------	0-6	Very cobbly clay loam.	CL, GC, SC	A-2, A-4, A-6, A-7	15-40	40-75	35-70	30-65	25-60	25-47	8-25
	6-13	Very cobbly loam, very cobbly clay loam, very gravelly clay loam.	CL, GC, SC	A-2, A-4, A-6, A-7	25-50	40-75	35-70	30-65	25-60	25-47	8-25
	13-48	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
44:*											
Throck----------	0-6	Stony clay loam	CL	A-6, A-7	5-30	70-90	70-90	60-90	50-85	30-45	18-28
	6-30	Silty clay loam, clay.	CL, SC, GC	A-6, A-7	0-5	55-99	55-99	50-99	40-90	35-48	20-30
	30-42	Clay, silty clay loam, shaly silty clay.	CL	A-6, A-7	0	95-100	95-100	90-100	75-95	30-50	14-30
Speck----------	0-7	Stony clay loam	CL	A-6, A-7-6	5-25	80-100	80-100	80-95	70-90	30-45	15-25
	7-18	Clay, clay loam, cobbly clay.	CL, CH	A-7-6	0-25	85-100	80-100	70-100	55-95	45-65	25-40
	18-22	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer. Absence of an entry indicates that data not available or were not estimated]

Map symbol and soil name	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	Pct	In/hr	In/in	pH				
1, 2----------	0-9	20-27	0.6-2.0	0.15-0.20	6.6-8.4	Moderate-------	0.37	5	6
Abilene	9-32	35-45	0.2-0.6	0.14-0.18	6.6-8.4	Moderate-------	0.28		
	32-80	---	0.2-0.6	0.12-0.15	7.9-8.4	Moderate-------	0.32		
3----------	0-8	10-20	0.6-2.0	0.11-0.15	5.6-7.3	Low----------	0.37	2	3
Bonti	8-30	35-50	0.2-0.6	0.15-0.20	5.1-6.0	Moderate-------	0.32		
	30-35	---	---	---	---	---	---		
4:*									
Bonti----------	0-8	10-20	0.6-2.0	0.11-0.15	5.6-7.3	Low----------	0.37	2	3
	8-25	35-50	0.2-0.6	0.15-0.20	5.1-6.0	Moderate-------	0.32		
	25-35	---	---	---	---	---	---		
Callahan--------	0-5	15-30	0.2-0.6	0.15-0.20	6.6-8.4	Low----------	0.32	4	5
	5-26	35-50	<0.06	0.12-0.18	7.4-8.4	Moderate-------	0.32		
	26-45	---	---	---	---	---	---		
Exray----------	0-6	7-22	0.6-2.0	0.08-0.14	6.1-7.3	Low----------	0.32	1	8
	6-15	35-50	0.2-0.6	0.12-0.20	5.6-6.5	Moderate-------	0.32		
	15-35	---	---	---	---	---	---		
5, 6----------	0-4	15-30	0.2-0.6	0.15-0.20	6.6-8.4	Low----------	0.32	4	5
Callahan	4-38	35-50	<0.06	0.12-0.18	7.4-8.4	Moderate-------	0.32		
	38-45	---	---	---	---	---	---		
7----------	0-14	5-15	2.0-6.0	0.05-0.10	5.6-7.3	Very low-------	0.20	5	2
Chaney	14-45	35-50	0.06-0.2	0.15-0.18	5.6-7.3	Moderate-------	0.28		
	45-72	20-45	0.06-0.2	0.15-0.18	5.6-8.0	Moderate-------	0.28		
8----------	0-8	5-15	2.0-6.0	0.04-0.08	5.6-7.3	Very low-------	0.20	5	8
Chaney	8-41	35-50	0.06-0.2	0.11-0.18	5.6-7.3	Moderate-------	0.28		
	41-70	20-50	0.06-0.2	0.15-0.18	5.6-8.0	Moderate-------	0.28		
9----------	0-18	5-15	2.0-6.0	0.05-0.10	5.6-7.3	Very low-------	0.30	5	2
Chaney Variant	18-50	35-50	0.06-0.2	0.15-0.18	5.6-7.3	Moderate-------	0.28		
	50-65	35-45	0.06-0.2	0.15-0.18	5.6-8.4	Moderate-------	0.28		
10----------	0-10	20-35	0.6-2.0	0.10-0.15	7.9-8.4	Low----------	0.28	1	4L
Cho	10-15	---	---	---	---	---	---		
	15-50	---	---	---	---	---	---		
11----------	0-10	5-15	2.0-6.0	0.07-0.11	6.1-7.3	Very low-------	0.20	5	2
Cisco	10-51	20-35	0.6-2.0	0.15-0.19	6.1-7.8	Moderate-------	0.32		
	51-65	15-30	2.0-6.0	0.11-0.17	7.4-8.4	Low----------	0.32		
12, 13----------	0-9	10-20	2.0-6.0	0.11-0.15	6.1-7.3	Low----------	0.37	5	3
Cisco	9-49	20-35	0.6-2.0	0.15-0.19	6.1-7.8	Moderate-------	0.32		
	49-65	15-30	2.0-6.0	0.11-0.17	7.4-8.4	Low----------	0.32		
14,* 15:*									
Cisco----------	0-6	10-20	2.0-6.0	0.11-0.15	6.1-7.3	Low----------	0.37	5	3
	6-43	20-35	0.6-2.0	0.15-0.19	6.1-7.8	Moderate-------	0.32		
	43-50	15-30	2.0-6.0	0.11-0.17	7.4-8.4	Low----------	0.32		
Hext----------	0-6	10-25	0.6-2.0	0.11-0.18	7.4-8.4	Low----------	0.24	1	3
	6-28	10-25	0.6-2.0	0.11-0.18	7.9-8.4	Low----------	0.24		
	28-35	---	---	---	---	---	---		
Pedernales------	0-7	8-20	0.6-2.0	0.12-0.17	6.1-7.8	Low----------	0.32	5	3
	7-38	35-55	0.2-0.6	0.15-0.20	6.1-7.8	Moderate-------	0.28		
	38-45	20-50	0.2-0.6	0.15-0.20	7.9-8.4	Moderate-------	0.28		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	Pct	In/hr	In/in	pH				
16:*									
Demona	0-25	5-15	2.0-6.0	0.05-0.10	5.6-7.8	Very low	0.17	5	2
	25-61	35-50	0.2-0.6	0.15-0.18	5.1-6.5	Moderate	0.24		
	61-70	20-45	0.2-0.6	0.14-0.18	5.1-6.5	Moderate	0.24		
Patilo	0-58	2-15	6.0-20	0.05-0.08	5.6-7.3	Very low	0.17	5	1
	58-80	18-35	0.2-0.6	0.14-0.18	5.1-6.5	Low	0.24		
17	0-27	35-50	0.2-0.6	0.15-0.22	7.9-8.4	Moderate	0.32	5	4
Frio	27-70	35-50	0.2-0.6	0.11-0.22	7.9-8.4	Moderate	0.32		
18:*									
Frio	0-24	35-50	0.2-0.6	0.15-0.22	7.9-8.4	Moderate	0.32	5	4
	24-50	35-50	0.2-0.6	0.11-0.22	7.9-8.4	Moderate	0.32		
Gageby	0-60	18-35	0.6-2.0	0.16-0.20	7.9-8.4	Moderate	0.28	5	6
19	0-60	18-35	0.6-2.0	0.16-0.20	7.9-8.4	Moderate	0.28	5	6
Gageby									
20:*									
Hext	0-7	10-25	0.6-2.0	0.11-0.18	7.4-8.4	Low	0.24	1	3
	7-24	10-25	0.6-2.0	0.11-0.18	7.9-8.4	Low	0.24		
	24-35	---	---	---	---	---	---		
Oplin	0-17	20-35	0.6-2.0	0.10-0.15	7.9-8.4	Low	0.10	1	8
	17-65	---	---	---	---	---	---		
Brackett	0-13	15-35	0.2-0.6	0.10-0.20	7.9-8.4	Low	0.32	2	4L
	13-20	---	---	---	---	---	---		
21, 22	0-43	40-60	<0.06	0.12-0.18	7.9-8.4	Very high	0.32	5	4
Leeray	43-65	40-60	<0.06	0.10-0.15	7.9-8.4	High	0.32		
23:*									
Lueders	0-8	20-35	0.6-2.0	0.10-0.15	7.9-8.4	Low	0.32	1	8
	8-14	20-35	0.6-2.0	0.06-0.12	7.9-8.4	Low	0.32		
	14-20	---	---	---	---	---	---		
Speck	0-5	20-39	0.2-0.6	0.15-0.20	6.1-7.8	Moderate	0.32	1	6
	5-15	35-60	0.06-0.2	0.12-0.18	6.1-7.8	High	0.32		
	15-22	---	---	---	---	---	---		
24	0-16	35-45	0.2-0.6	0.15-0.20	7.9-8.4	Moderate	0.32	1	6
Mereta	16-22	---	---	---	---	---	0.32		
	22-60	---	---	---	---	---	---		
25, 26	0-39	38-60	0.06-0.2	0.15-0.20	7.9-8.4	High	0.32	5	4
Nukrum	39-65	38-60	0.06-0.2	0.15-0.20	7.9-8.4	High	0.32		
	65-70	30-55	0.06-0.2	0.13-0.18	7.9-8.4	High	0.32		
27	0-15	30-40	0.6-2.0	0.14-0.20	7.9-8.4	Moderate	0.28	5	4L
Nuvalde	15-49	30-40	0.6-2.0	0.12-0.18	7.9-8.4	Moderate	0.28		
	49-60	28-40	0.6-2.0	0.12-0.18	7.9-8.4	Moderate	0.32		
28:*									
Oplin	0-6	20-35	0.6-2.0	0.10-0.15	7.9-8.4	Low	0.10	1	8
	6-14	---	---	---	---	---	---		
Speck	0-6	20-39	0.2-0.6	0.10-0.18	6.1-7.8	Moderate	0.32	1	6
	6-14	35-60	0.06-0.2	0.10-0.15	6.1-7.8	High	0.32		
	18-22	---	---	---	---	---	---		
29:*									
Owens	0-3	35-60	<0.06	0.10-0.17	7.9-8.4	High	0.32	1	8
	3-17	35-60	<0.06	0.13-0.17	7.9-8.4	High	0.32		
	17-30	35-60	<0.06	0.03-0.08	7.9-8.4	High	0.37		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	Pct	In/hr	In/in	pH				
29:*									
Throck	0-4	35-45	0.2-0.6	0.10-0.18	7.9-8.4	Moderate	0.32	3	4
	4-24	35-45	0.06-0.2	0.12-0.20	7.9-8.4	Moderate	0.32		
	24-42	35-45	0.06-0.2	0.10-0.18	7.9-8.4	Moderate	0.32		
30	0-12	5-15	2.0-6.0	0.07-0.11	6.1-7.8	Low	0.20	5	2
Pedernales	12-40	35-55	0.2-0.6	0.15-0.20	6.1-7.8	Moderate	0.28		
	40-70	20-50	0.2-0.6	0.15-0.20	7.9-8.4	Moderate	0.28		
31, 32	0-6	8-20	0.6-2.0	0.12-0.17	6.1-7.8	Low	0.32	5	3
Pedernales	6-30	35-55	0.2-0.6	0.15-0.20	6.1-7.8	Moderate	0.28		
	30-70	20-50	0.2-0.6	0.15-0.20	7.9-8.4	Moderate	0.28		
33.*									
Pits									
34	0-8	24-35	0.6-2.0	0.12-0.20	6.6-8.4	Moderate	0.32	2	6
Rowden	8-27	35-60	0.06-0.2	0.10-0.20	7.4-8.4	High	0.32		
	27-32	---	---	---	---	---	---		
35, 36	0-6	35-45	0.2-0.6	0.15-0.20	7.9-8.4	Moderate	0.32	5	6
Rowena	6-46	35-50	0.2-0.6	0.14-0.18	7.9-8.4	High	0.32		
	46-60	35-50	0.2-0.6	0.11-0.15	7.9-8.4	High	0.32		
37, 38	0-7	20-35	0.6-2.0	0.15-0.20	6.6-7.8	Moderate	0.32	5	6
Sagerton	7-40	35-45	0.2-0.6	0.14-0.19	6.6-8.4	Moderate	0.32		
	40-65	35-45	0.2-0.6	0.10-0.17	7.9-8.4	Moderate	0.32		
39	0-7	20-39	0.2-0.6	0.15-0.20	6.1-7.8	Moderate	0.32	1	6
Speck	7-18	35-60	0.06-0.2	0.12-0.18	6.1-7.8	High	0.32		
	18-22	---	---	---	---	---	---		
40:*									
Speck	0-6	20-39	0.2-0.6	0.10-0.18	6.1-7.8	Moderate	0.32	1	6
	6-18	35-60	0.06-0.2	0.10-0.15	6.1-7.8	High	0.32		
	18-22	---	---	---	---	---	---		
Throck	0-7	35-45	0.2-0.6	0.10-0.18	7.9-8.4	Moderate	0.32	3	4
	7-29	35-45	0.06-0.2	0.12-0.20	7.9-8.4	Moderate	0.32		
	29-45	35-45	0.06-0.2	0.10-0.18	7.9-8.4	Moderate	0.32		
41	0-6	35-45	0.2-0.6	0.12-0.20	7.9-8.4	Moderate	0.32	3	4
Throck	6-34	35-45	0.06-0.2	0.12-0.20	7.9-8.4	Moderate	0.32		
	34-40	35-45	0.06-0.2	0.10-0.18	7.9-8.4	Moderate	0.32		
42:*									
Throck	0-6	35-45	0.2-0.6	0.12-0.20	7.9-8.4	Moderate	0.32	3	4
	6-28	35-45	0.06-0.2	0.12-0.20	7.9-8.4	Moderate	0.32		
	28-42	35-45	0.06-0.2	0.10-0.18	7.9-8.4	Moderate	0.32		
Callahan	0-6	15-30	0.2-0.6	0.15-0.20	6.6-8.4	Low	0.32	4	6
	6-35	35-50	<0.06	0.12-0.18	7.4-8.4	Moderate	0.32		
	35-45	---	---	---	---	---	---		
Owens	0-4	35-60	<0.06	0.13-0.17	7.9-8.4	High	0.32	1	4
	4-18	35-60	<0.06	0.13-0.17	7.9-8.4	High	0.32		
	18-30	40-60	<0.06	0.03-0.08	7.9-8.4	High	0.37		
43:*									
Throck	0-5	35-45	0.2-0.6	0.10-0.18	7.9-8.4	Moderate	0.32	3	8
	5-31	35-45	0.06-0.2	0.12-0.20	7.9-8.4	Moderate	0.32		
	31-40	35-45	0.06-0.2	0.10-0.18	7.9-8.4	Moderate	0.32		
Owens	0-4	35-60	<0.06	0.10-0.17	7.9-8.4	High	0.32	1	8
	4-17	35-60	<0.06	0.13-0.17	7.9-8.4	High	0.32		
	17-30	35-60	<0.06	0.03-0.08	7.9-8.4	High	0.37		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	Pct	In/hr	In/in	pH				
43:*									
Lueders	0-6	20-35	0.6-2.0	0.10-0.15	7.9-8.4	Low	0.32	1	8
	6-13	20-35	0.6-2.0	0.06-0.12	7.9-8.4	Low	0.32		
	13-48	---	---	---	---	---	---		
44:*									
Throck	0-6	35-45	0.2-0.6	0.10-0.18	7.9-8.4	Moderate	0.32	3	4
	6-30	35-45	0.06-0.2	0.12-0.20	7.9-8.4	Moderate	0.32		
	30-42	35-45	0.06-0.2	0.10-0.18	7.9-8.4	Moderate	0.32		
Speck	0-7	20-39	0.2-0.6	0.10-0.18	6.1-7.8	Moderate	0.32	1	6
	7-18	35-60	0.06-0.2	0.10-0.15	6.1-7.8	High	0.32		
	18-22	---	---	---	---	---	---		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the text explain terms such as "rare," "brief," "apparent," and "perched." The symbol < means less than; > means more than. The symbol + indicates ponding. Absence of an entry indicates that the feature is not a concern]

Map symbol and soil name	Hydrologic group	Flooding		High water table			Bedrock		Cemented pan		Risk of corrosion
		Frequency	Months	Depth	Kind	Months	Depth	Hardness	Depth	Hardness	Uncoated steel
				Ft			In		In		
1, 2---------- Abilene	C	None--------	---	>6.0	---	---	>60	---	---	---	High.
3---------- Bonti	C	None--------	---	>6.0	---	---	20-40	Hard	---	---	High.
4:*											
Bonti----------	C	None--------	---	>6.0	---	---	20-40	Hard	---	---	High.
Callahan---------	D	None--------	---	>6.0	---	---	20-40	Soft	---	---	High.
Exray----------	D	None--------	---	>6.0	---	---	10-20	Hard	---	---	High.
5, 6---------- Callahan	D	None--------	---	>6.0	---	---	20-40	Soft	---	---	High.
7, 8---------- Chaney	C	None--------	---	>6.0	---	---	>60	---	---	---	High.
9---------- Chaney	C	None--------	---	+2-0.5	Apparent	May-Oct	>60	---	---	---	High.
10---------- Cho	C	None--------	---	>6.0	---	---	>60	---	8-20	Thin	High.
11, 12, 13-------- Cisco	B	None--------	---	>6.0	---	---	>60	---	---	---	Moderate.
14,* 15:*											
Cisco----------	B	None--------	---	>6.0	---	---	>60	---	---	---	Moderate.
Hext----------	B	None--------	---	>6.0	---	---	20-40	Soft	---	---	Moderate.
Pedernales-------	C	None--------	---	>6.0	---	---	>60	---	---	---	High.
16:*											
Demona----------	C	None--------	---	1.5-3.5	Perched	May-Oct	>60	---	---	---	High.
Patilo----------	B	None--------	---	4.0-6.0	Perched	May-Oct	>60	---	---	---	High.
17---------- Frio	B	Occasional--	Apr-Oct	>6.0	---	---	>60	---	---	---	High.
18:*											
Frio----------	B	Frequent----	Apr-Oct	>6.0	---	---	>60	---	---	---	High.
Gageby----------	B	Frequent----	Apr-Oct	>6.0	---	---	>60	---	---	---	Moderate.
19---------- Gageby	B	Occasional--	Apr-Oct	>6.0	---	---	>60	---	---	---	Moderate.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydrologic group	Flooding		High water table			Bedrock		Cemented pan		Risk of corrosion
		Frequency	Months	Depth	Kind	Months	Depth	Hardness	Depth	Hardness	Uncoated steel
				Ft			In		In		
20:*											
Hext	B	None	---	>6.0	---	---	20-40	Soft	---	---	Moderate.
Oplin	C	None	---	>6.0	---	---	7-20	Hard	---	---	Moderate.
Brackett	C	None	---	>6.0	---	---	10-20	Soft	---	---	High.
21, 22--Leeray	D	None	---	>6.0	---	---	>60	---	---	---	High.
23:*											
Lueders	C	None	---	>6.0	---	---	7-20	Hard	---	---	Moderate.
Speck	D	None	---	>6.0	---	---	14-20	Hard	---	---	High.
24--Mereta	C	None	---	>6.0	---	---	>60	---	14-20	Thin	High.
25, 26--Nukrum	D	None	---	>6.0	---	---	>60	---	---	---	High.
27--Nuvalde	B	None	---	>6.0	---	---	>60	---	---	---	High.
28:*											
Oplin	C	None	---	>6.0	---	---	7-20	Hard	---	---	Moderate.
Speck	D	None	---	>6.0	---	---	14-20	Hard	---	---	High.
29:*											
Owens	D	None	---	>6.0	---	---	>60	---	---	---	High.
Throck	C	None	---	>6.0	---	---	40-80	Soft	---	---	High.
30, 31, 32--Pedernales	C	None	---	>6.0	---	---	>60	---	---	---	High.
33.* Pits											
34--Rowden	C	None	---	>6.0	---	---	20-40	Hard	---	---	High.
35, 36--Rowena	C	None	---	>6.0	---	---	>60	---	---	---	High.
37, 38--Sagerton	C	None	---	>6.0	---	---	>60	---	---	---	Moderate.
39--Speck	D	None	---	>6.0	---	---	14-20	Hard	---	---	High.
40:*											
Speck	D	None	---	>6.0	---	---	14-20	Hard	---	---	High.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydrologic group	Flooding		High water table			Bedrock		Cemented pan		Risk of corrosion
		Frequency	Months	Depth	Kind	Months	Depth	Hardness	Depth	Hardness	Uncoated steel
				Ft			In		In		
40:*											
Throck	C	None	---	>6.0	---	---	40-80	Soft	---	---	High.
41---------- Throck	C	None	---	>6.0	---	---	40-80	Soft	---	---	High.
42:*											
Throck	C	None	---	>6.0	---	---	40-80	Soft	---	---	High.
Callahan	D	None	---	>6.0	---	---	20-40	Soft	---	---	High.
Owens	D	None	---	>6.0	---	---	>60	---	---	---	High.
43:*											
Throck	C	None	---	>6.0	---	---	40-80	Soft	---	---	High.
Owens	D	None	---	>6.0	---	---	>60	---	---	---	High.
Lueders	C	None	---	>6.0	---	---	7-20	Hard	---	---	Moderate.
44:*											
Throck	C	None	---	>6.0	---	---	40-80	Soft	---	---	High.
Speck	D	None	---	>6.0	---	---	14-20	Hard	---	---	High.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING INDEX TEST DATA

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution[1]									Liquid limit[2]	Plasticity index[2]	Specific gravity	Shrinkage		
			Percentage passing sieve--						Percentage smaller than--						Limit	Linear	Ratio
	AASHTO	Unified	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm						
												Pct		G/cc	Pct	Pct	Pct
Gageby loam:[3] (S77TX-059-001)																	
A12-------6 to 16	A-6 (09)	CL	100	100	100	100	100	76	66	26	21	30	15	2.65	15.0	8.2	1.8
A13------16 to 29	A-6 (08)	CL	100	100	100	100	100	70	54	24	21	28	15	2.66	15.0	7.0	1.8
B21------29 to 41	A-6 (06)	CL	100	100	100	100	100	66	56	25	21	28	14	2.66	15.0	7.0	1.8
Nukrum clay:[4] (S77TX-059-002)																	
Ap--------0 to 7	A-7-6(23)	CL	100	100	100	99	98	78	73	45	38	47	30	2.69	10.0	17.0	2.0
A1--------7 to 39	A-7-6(30)	CH	100	100	100	99	98	83	81	53	46	53	36	2.70	11.0	17.0	2.0
Nuvalde clay loam:[5] (S75TX-059-006)																	
Ap--------0 to 8	A-6 (18)	CL	100	100	100	100	99	85	81	43	34	38	22	2.66	16.0	11.3	1.9
B21ca----18 to 29	A-6 (15)	CL	100	100	99	97	94	70	66	42	36	39	24	2.68	13.0	12.7	1.9
B22ca----29 to 38	A-6 (12)	CL	100	98	98	96	93	75	73	51	40	34	18	2.68	15.0	9.3	1.8
Cca-------38 to 50	A-6 (12)	CL	100	100	99	99	96	80	79	55	39	31	17	2.67	14.0	9.0	1.9
Patilo fine sand:[6] (S75TX-059-003)																	
A2--------5 to 58	A-2-4(00)	SP-SM	100	100	100	100	98	5	5	1	1	22	3	2.65	17.0	0.3	1.7
B21t-----58 to 66	A-6 (03)	SC	100	100	100	100	99	38	38	29	28	31	19	2.65	16.0	8.1	1.8
Rowden clay loam:[7] (S78TX-059-004)																	
Ap--------0 to 8	A-6 (09)	CL	100	100	100	99	98	60	55	34	27	36	20	2.65	12.0	11.9	1.9
B22t-----15 to 27	A-7-6(13)	CL	100	100	100	99	98	61	56	45	42	45	26	2.71	14.0	14.5	1.9

See footnotes at end of table.

TABLE 17.--ENGINEERING INDEX TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution[1]									Liquid limit[2]	Plasticity index[2]	Specific gravity	Shrinkage		
			Percentage passing sieve--						Percentage smaller than--								
	AASHTO	Unified	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm				Limit	Linear	Ratio
												Pct		G/cc	Pct	Pct	Pct
Speck clay loam:[8] (S75TX-059-005)																	
A1--------0 to 7	A-7-6(18)	CL	100	100	99	98	97	78	75	41	34	41	25	2.62	16.0	11.8	1.8
B2t--------7 to 18	A-7-6(32)	CH	100	100	100	99	98	86	80	58	50	57	35	2.68	12.0	19.2	1.9

[1]For soil materials larger than 3/8 inch, square mesh wire sieves were used that are slightly larger than equivalent round sieves, but these differences do not seriously affect the data.

[2]Liquid limit and plastic index values were determined by the AASHTO-89 and AASHTO-90 methods except that soil was added to water.

[3]0.5 mile north on Texas Highway 206 from Texas Highway 36 in Cross Plains, 1.5 miles west and north on county road, 0.15 mile east in field.

[4]0.2 mile west of Cross Plains on Texas Highway 36, 0.1 mile south and 6.8 miles west on Farm Road 2787, 10 feet north in field.

[5]5.8 miles northwest on Texas Highway 36 from Farm Road 604 at Denton community, 0.7 mile west on county road, 50 feet north of road. This soil is considered to be a taxadjunct to the Nuvalde series because it has about 20 percent coarser material than very fine sand in the B horizon.

[6]7.5 miles south on U.S. Highway 283 from Texas Highway 425 in Baird, 1.1 miles east on county road, 27 feet south of road in pastureland.

[7]0.1 mile south and 5.7 miles west on Farm Road 2287 from Texas Highway 36 in Cross Plains, 10 feet north in field.

[8]1.0 mile south on Farm Road 3146 from Texas Highway 36 at Rowden, 0.8 mile west on county road, 78 feet south.

TABLE 18.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Abilene	Fine, mixed, thermic Pachic Argiustolls
Bonti	Fine, mixed, thermic Ultic Paleustalfs
Brackett	Loamy, carbonatic, thermic, shallow Typic Ustochrepts
Callahan	Fine, mixed, thermic Typic Haplustalfs
Chaney	Fine, mixed, thermic Aquic Paleustalfs
Chaney Variant	Fine, mixed, thermic Aquic Paleustalfs
Cho	Loamy, carbonatic, thermic, shallow Petrocalcic Calciustolls
Cisco	Fine-loamy, siliceous, thermic Udic Haplustalfs
*Demona	Clayey, mixed, thermic Aquic Arenic Paleustalfs
Exray	Clayey, mixed, thermic Lithic Rhodustalfs
Frio	Fine, mixed, thermic Cumulic Haplustolls
Gageby	Fine-loamy, mixed, thermic Cumulic Haplustolls
Hext	Coarse-loamy, mixed, thermic Typic Ustochrepts
Leeray	Fine, montmorillonitic, thermic Typic Chromusterts
Lueders	Loamy-skeletal, carbonatic, thermic Lithic Calciustolls
Mereta	Clayey, mixed, thermic, shallow Petrocalcic Calciustolls
Nukrum	Fine, mixed, thermic Vertic Haplustolls
*Nuvalde	Fine-silty, mixed, thermic Typic Calciustolls
Oplin	Loamy-skeletal, carbonatic, thermic Lithic Calciustolls
Owens	Clayey, mixed, thermic, shallow Typic Ustochrepts
Patilo	Loamy, siliceous, thermic Grossarenic Paleustalfs
Pedernales	Fine, mixed, thermic Udic Paleustalfs
Rowden	Fine, mixed, thermic Typic Argiustolls
Rowena	Fine, mixed, thermic Vertic Calciustolls
Sagerton	Fine, mixed, thermic Typic Paleustolls
Speck	Clayey, mixed, thermic Lithic Argiustolls
Throck	Fine, mixed, thermic Typic Ustochrepts

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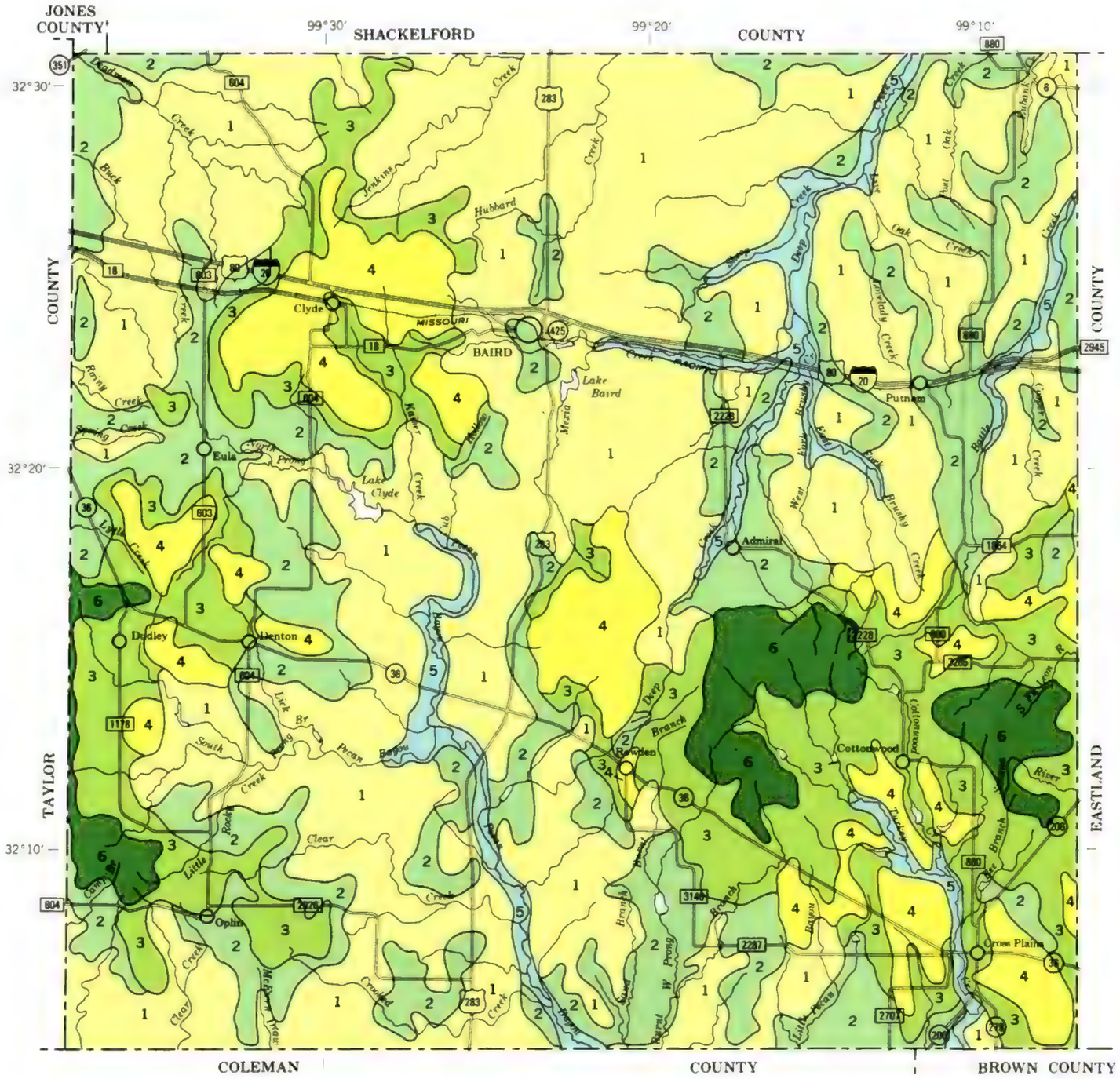


LEGEND

1	THROCK-SPECK-LUEDERS: Moderately deep to very shallow, undulating to hilly, stony, cobbly, and loamy soils; on uplands
2	LEERAY-SAGERTON-NUKRUM: Deep, nearly level to gently sloping, clayey and loamy soils; on uplands
3	PEDERNALES-CISCO-HEXT: Deep and moderately deep, gently sloping to undulating, loamy soils; on uplands
4	CHANEY-DEMONA: Deep, gently sloping, sandy soils on uplands
5	FRIO-GAGEBY: Deep, nearly level, loamy soils on flood plains
6	OPLIN-HEXT-BRACKETT: Very shallow to moderately deep, undulating to hilly, flaggy, loamy, and gravelly soils; on uplands

Compiled 1980

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

*Texture refers to the surface layer of the major soils.

N

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION

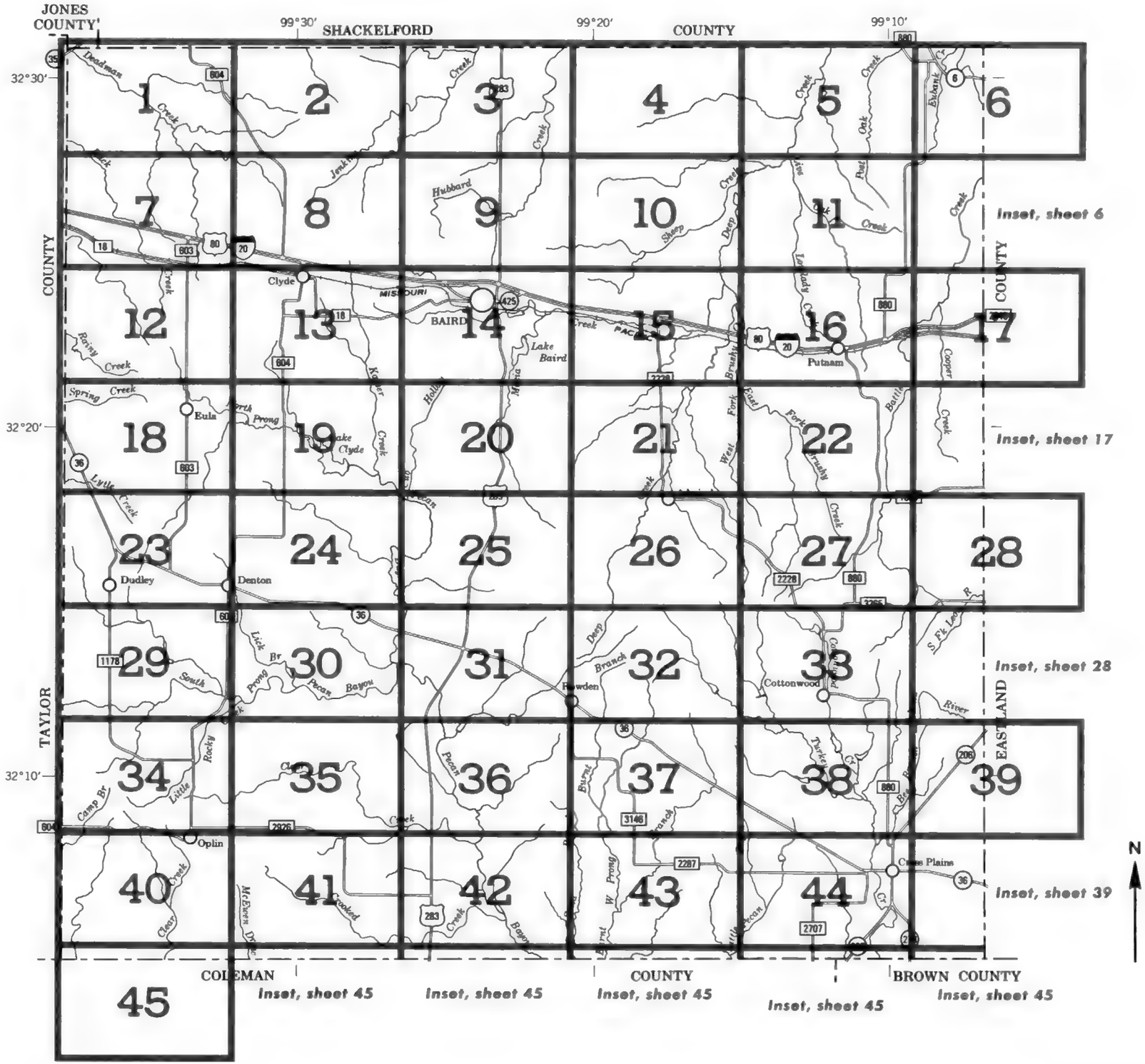
GENERAL SOIL MAP*

CALLAHAN COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km



Original text from each individual map sheet read:
This map is compiled on 1976 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

INDEX TO MAP SHEETS

CALLAHAN COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline
- AD HOC BOUNDARY (label) (Hedin Xmmp)
- Small airport, airfield, park, oilfield, cemetery, or flood pool (FLOOD POOL LINE)

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate (21)
- Federal (173)
- State (28)
- County, farm or ranch (1283)

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small (water, w)

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) (Indian Mound)
- Located object (label) (Tower)
- Tank (label) (Gas)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) (CANAL)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial (water, w)
- Intermittent (int, i)

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS (25 / 23)

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot

SOIL LEGEND

Map symbols will be published as arabic numbers. Most units in the legend are narrowly defined. Soil names followed by the superscript 1/ are broadly defined units. These units were mapped at a lower intensity and in larger delineations, but mapping has been controlled well enough to be interpreted for the expected use of the soils

SYMBOL	NAME
1	Abilene loam, 0 to 1 percent slopes
2	Abilene loam, 1 to 3 percent slopes
3	Bonti fine sandy loam, 1 to 3 percent slopes
4	Bonti-Callahan-Exray complex, 1 to 8 percent slopes
5	Callahan loam, 1 to 3 percent slopes
6	Callahan loam, 2 to 5 percent slopes, eroded
7	Chaney loamy fine sand, 1 to 3 percent slopes
8	Chaney stony sandy loam, 1 to 8 percent slopes
9	Chaney Variant loamy fine sand, 0 to 1 percent slopes
10	Cho gravelly loam, 1 to 5 percent slopes
11	Cisco loamy fine sand, 1 to 3 percent slopes
12	Cisco fine sandy loam, 1 to 3 percent slopes
13	Cisco fine sandy loam, 1 to 5 percent slopes, eroded
14	Cisco-Hext-Pedernales complex, 1 to 5 percent slopes
15	Cisco-Hext-Pedernales association, undulating 1/
16	Demona Patilo complex, 1 to 5 percent slopes
17	Frio clay loam, occasionally flooded
18	Frio-Gageby association, frequently flooded 1/
19	Gageby loam, occasionally flooded
20	Hext Oplin-Brackett association, hilly 1/
21	Leeray clay, 0 to 1 percent slopes
22	Leeray clay, 1 to 3 percent slopes
23	Lueders-Speck association, undulating 1/
24	Mereta clay loam, 1 to 3 percent slopes
25	Nukrum clay, 1 to 3 percent slopes
26	Nukrum clay, 3 to 5 percent slopes
27	Nuvalde clay loam, 1 to 3 percent slopes
28	Oplin-Speck association, undulating 1/
29	Owens-Throck association, hilly 1/
30	Pedernales loamy fine sand, 1 to 3 percent slopes
31	Pedernales fine sandy loam, 1 to 3 percent slopes
32	Pedernales fine sandy loam, 1 to 3 percent slopes,eroded
33	Pits
34	Rowden clay loam, 1 to 3 percent slopes
35	Rowena clay loam, 0 to 1 percent slopes
36	Rowena clay loam, 1 to 3 percent slopes
37	Sagerton loam, 0 to 1 percent slopes
38	Sagerton loam, 1 to 3 percent slopes
39	Speck clay loam, 1 to 3 percent slopes
40	Speck-Throck association, gently undulating 1/
41	Throck clay loam, 2 to 5 percent slopes
42	Throck-Callahan-Owens association, undulating 1/
43	Throck-Owens-Lueders association, hilly 1/
44	Throck-Speck association, undulating 1/

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 1

1

N

2 Miles

10000 Feet

(Joins sheet 2)

5000

Scale 1:24000

1:345 000 FEET

JONES COUNTY

PREVIOUSLY PUBLISHED BOUNDARY

SHACKELFORD COUNTY

TAYLOR COUNTY

INDEFINITE BOUNDARY

Deadman Creek

Buck Creek

604

(Joins sheet 7)

1:370 000 FEET

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 2

(2)

N

SHACKELFORD COUNTY

Flattop

Spring Creek

Deadman Draw

Jenkins Creek

(Joins sheet 1)

(Joins sheet 3)

(Joins sheet 8)

604

2 Miles 1 0 1

10000 Feet 5000 0

Scale 1:24000

1" = 5000 FEET

1" = 4000 FEET

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 3

3

N

SHACKELFORD COUNTY

Deadman Draw

Creek

Jenkins Creek

Hubbard Creek

(Joins sheet 2)

(Joins sheet 4)

(Joins sheet 9)

2 Miles

10000 Feet

Scale 1:24000

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 4

4

N

SHACKELFORD COUNTY

1,460,000 FEET

2 Miles

10000 Feet

1

5000

Scale 1:24000

0

1000

2000

3000

4000

5000

(Joins sheet 3)

(Joins sheet 5)

1,430,000 FEET

(Joins sheet 10)

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 5

SHACKELFORD COUNTY

5

N

2 Miles

10000 Feet

Scale 1:24000

5000

4000

3000

2000

1000

0

0

1000

2000

3000

4000

5000

(Joins sheet 6)

(Joins sheet 4)

(Joins sheet 11)

Deep Creek

Oak Creek

Post

6

N

2 Miles

10000 Feet

1 5000

Scale 1:24000

1 5000 ¾ 4000 ½ 3000 ¼ 2000 0 1000 0

(Joins sheet 5)

1,500,000 FEET

(Joins lower left)

(Joins sheet 11)

EASTLAND COUNTY BOUNDARY INDEFINITE

Eubanks Creek

Battle Creek

880

1,490,000 FEET

(Joins upper right)

(Joins sheet 17)

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 7

1 345 000 FEET

(Joins sheet 1)

7

N

2 Miles

10000 Feet

(Joins sheet 8)

1

5000

Scale 1:24000

COUNTY BOUNDARY

TAYLOR

INDEFINITE

Buck Creek

Deadmn Creek

TEXAS PACIFIC

(Joins sheet 12)

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 8

8

N

Scale 1:24000

2 Miles 10000 Feet

1 5000

(Joins sheet 2)

1 400 000 FEET

(Joins sheet 7)

(Joins sheet 9)

(Joins sheet 13)

TEXAS

CLYDE

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 9

9

N

2 Miles

10000 Feet

5000

Scale 1:24000

(Joins sheet 3)

(Joins sheet 8)

(Joins sheet 10)

(Joins sheet 14)

Hubbard Creek

Hubbard Creek

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 10

10

N

(Joins sheet 4)

(Joins sheet 9)

(Joins sheet 11)

(Joins sheet 15)

1 460 000 FEET

1 430 000 FEET

Sheep Creek

Deep Creek

2 Miles

10000 Feet

5000

Scale 1:24000

0 0 1000 2000 3000 4000 5000

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 11

11

N

2 Miles

10000 Feet

5000

Scale 1:24000

1 460 000 FEET

(Joins sheet 5)

(Joins inset, sheet 6)

(Joins sheet 10)

(Joins sheet 16)

1 485 000 FEET

Creek

Creek

Sheep

Deep

Live

Oak

Creek

Post

Oak

Creek

Creek

Lovelady Creek

12

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 0 1000 2000 3000 4000 5000

(Joins sheet 7)

(Joins sheet 13)

(Joins sheet 18)

1 320,000 FEET

1 345,000 FEET

TAYLOR COUNTY

INDEFINITE BOUNDARY

Rainy Creek

603

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 13

13

N

2 Miles

10000 Feet

5000

Scale 1:24000

1 400 000 FEET

(Joins sheet 8)

(Joins sheet 12)

(Joins sheet 14)

(Joins sheet 19)

CLYDE

TEXAS PACIFIC

SEWAGE DISPOSAL PONDS

Kaiser Creek

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 14

14

N

(Joins sheet 9)

(Joins sheet 13)

(Joins sheet 15)

(Joins sheet 20)

BAIRD
(county Seat)

TP Lake

Baird Lake

Creek

TEXAS

PACIFIC

POOL

FLOOD

LINE

2 Miles

10000 Feet

Scale 1:24000

5000

0

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 15

15

N

1 430 000 FEET

(Joins sheet 10)

(Joins sheet 14)

(Joins sheet 16)

(Joins sheet 21)

Deep Creek

Mexia

TEXAS PACIFIC

2228

2 Miles

10000 Feet

Scale 1:24000

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 16

16

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0

0

1000

2000

3000

4000

5000

(Joins sheet 11)

(Joins sheet 15)

(Joins sheet 17)

(Joins sheet 22)

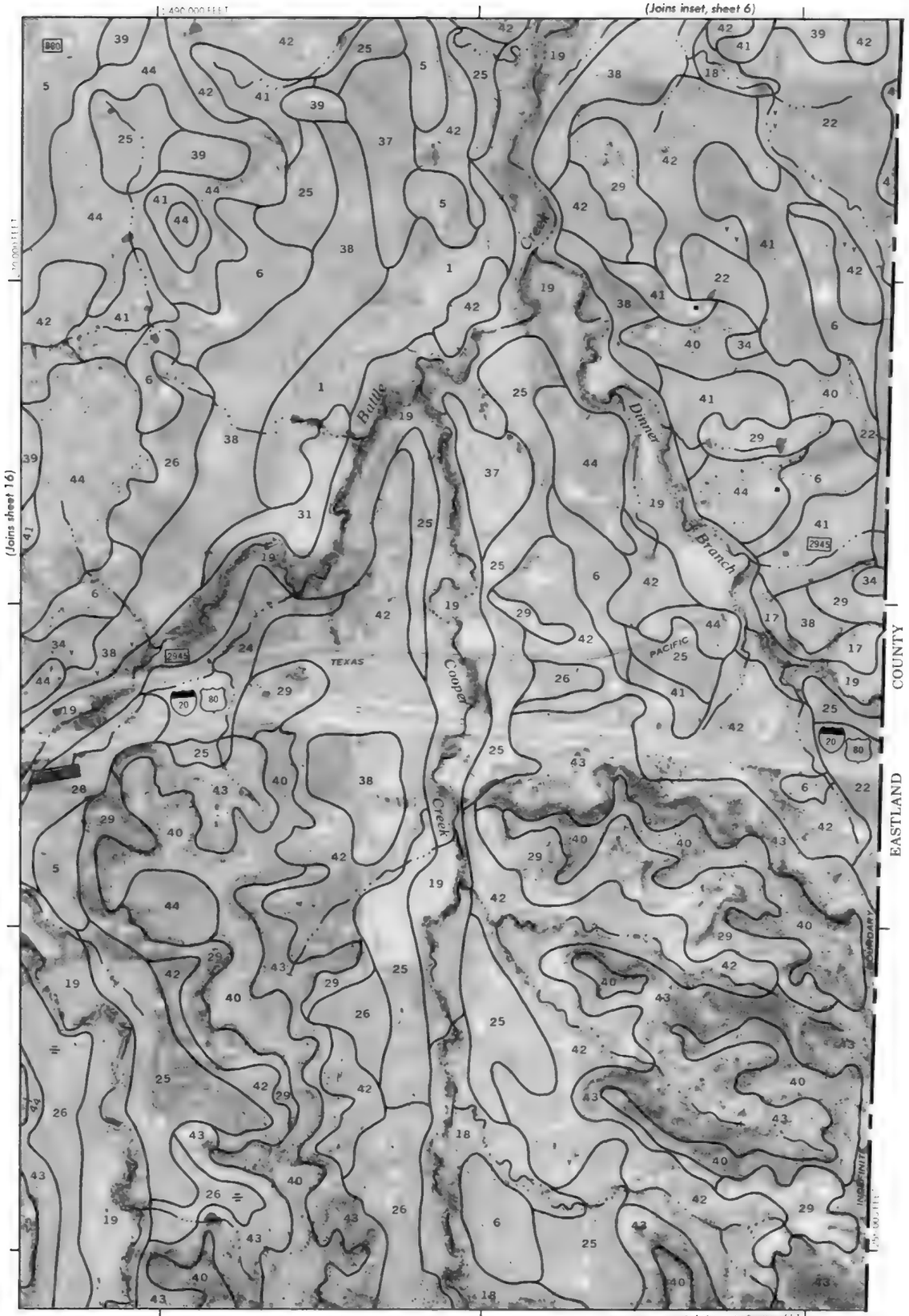
Deep Creek

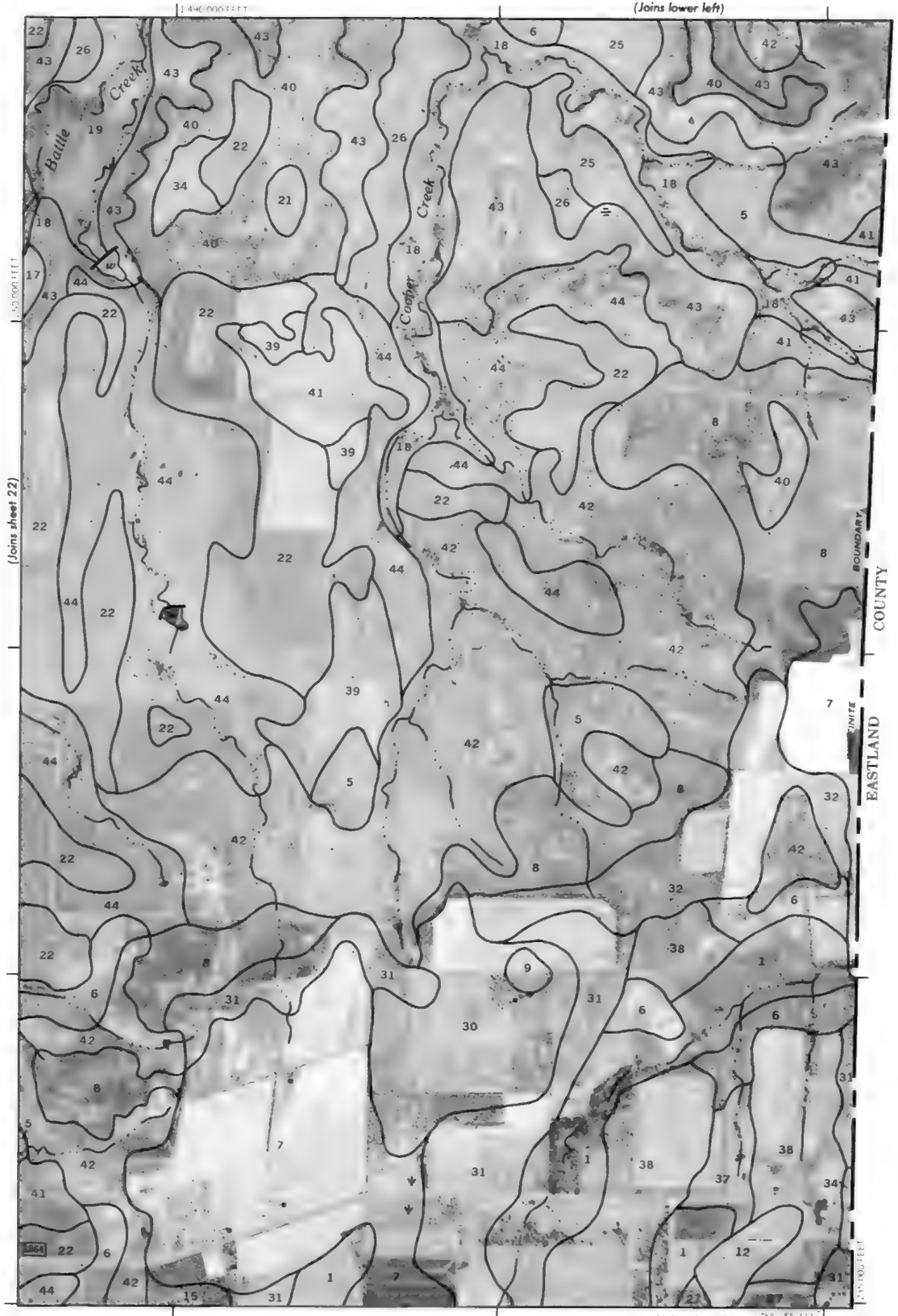
Brushy Creek

Putnam

TEXAS PACIFIC

Bluffe Creek





17

N

2 Miles 1

10000 Feet 5000

Scale 1:24000

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 18

18

N

(Joins sheet 12)

1 370 000 FEET

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 1000 2000 3000 4000 5000

Spring Creek

Eula

COUNTY

TAYLOR

INDEFINITE BOUNDARY

Lytle Creek

1 345 000 FEET

(Joins sheet 23)

(Joins sheet 19)

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 19

(Joins sheet 13)

(Joins sheet 18)

(Joins sheet 20)

(Joins sheet 24)

19

N

2 Miles

10000 Feet

Scale 1:24000

North Prong Pecan Bayou

Scott Airfield (Pvt.)

Lake Clyde

Kaiser Creek

3217

604

694

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 20

20

N

(Joins sheet 14)

(Joins sheet 19)

(Joins sheet 21)

(Joins sheet 25)

Mexia Creek

Cub Hollow

SITE

283

2 Miles 10000 Feet

1 5000

Scale 1:24000

1 5000 3/4 4000 1/2 3000 1/4 2000 0 1000 0

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 21

1,430,000 FEET

(Joins sheet 15)

(Joins sheet 20)

(Joins sheet 22)

(Joins sheet 26)

Deep Creek

Brushy Creek

West Fork

21

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 22

22

N

2 Miles

10000 Feet

Scale 1:24000

(Joins sheet 16)

(Joins sheet 21)

(Joins sheet 27)

(Joins inset, sheet 17)

Brushy Creek

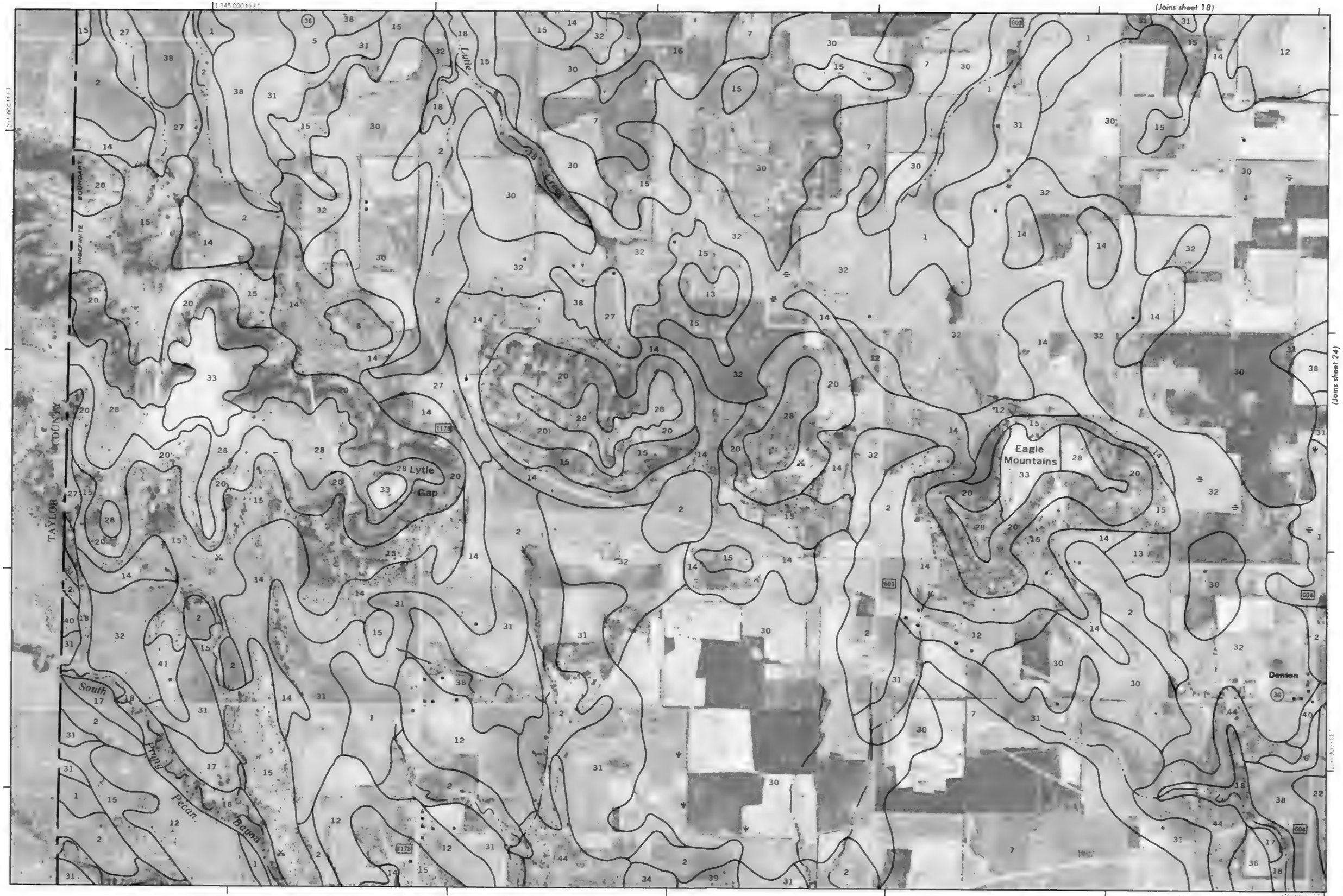
Brushy Fork West

Brushy Creek East

Battle Creek

Brushy Fork

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 23



CALLAHAN COUNTY, TEXAS — SHEET NUMBER 24

(24)

N

(Joins sheet 19)

(Joins sheet 23)

(Joins sheet 25)

(Joins sheet 30)

1,395,000 FEET

2 Miles

10000 Feet

Scale 1:24000

5000

0

1000

2000

3000

4000

5000

Rough Creek

Lick Branch

Pecan Bayou

SITE 6

604

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 25

1 400 000 FEET

235 000 FEET

(Joins sheet 20)

(Joins sheet 24)

(Joins sheet 26)

(Joins sheet 31)

1 425 000 FEET

220 000 FEET

Bayou

Pecan

Prong

North

Mexia

Creek

Pecan

Bayou

25

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0

1000

2000

3000

4000

5000

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 26

(26)

N

(Joins sheet 21)

(Joins sheet 25)

(Joins sheet 27)

(Joins sheet 32)

Admiral

Deep Creek

Spring Gap

2228

2 Miles

10000 Feet

Scale 1:24000

1 0 1

5000 4000 3000 2000 1000 0

1/4 1/2 3/4

1:24000 FEET

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 27

27

N

(Joins sheet 22)

(Joins sheet 26)

(Joins sheet 28)

(Joins sheet 33)

West Fork Brushy Creek

East Fork Brushy Creek

Battle Creek

Battle Creek

Airfield (Pvt.)

2228

880

3263

3266

2 Miles 1 0

10000 Feet 5000 0

Scale 1:24000

28

N

2 Miles 1 0 1

10000 Feet 5000 0 5000

Scale 1:24000

(Joins inset, sheet 17)

(Joins sheet 27)

(Joins upper right)

(Joins lower left)

(Joins sheet 33)

(Joins sheet 39)

3265

3263

Leon River

South Fork Leon River

Sabana River

Mexican Hat Hill

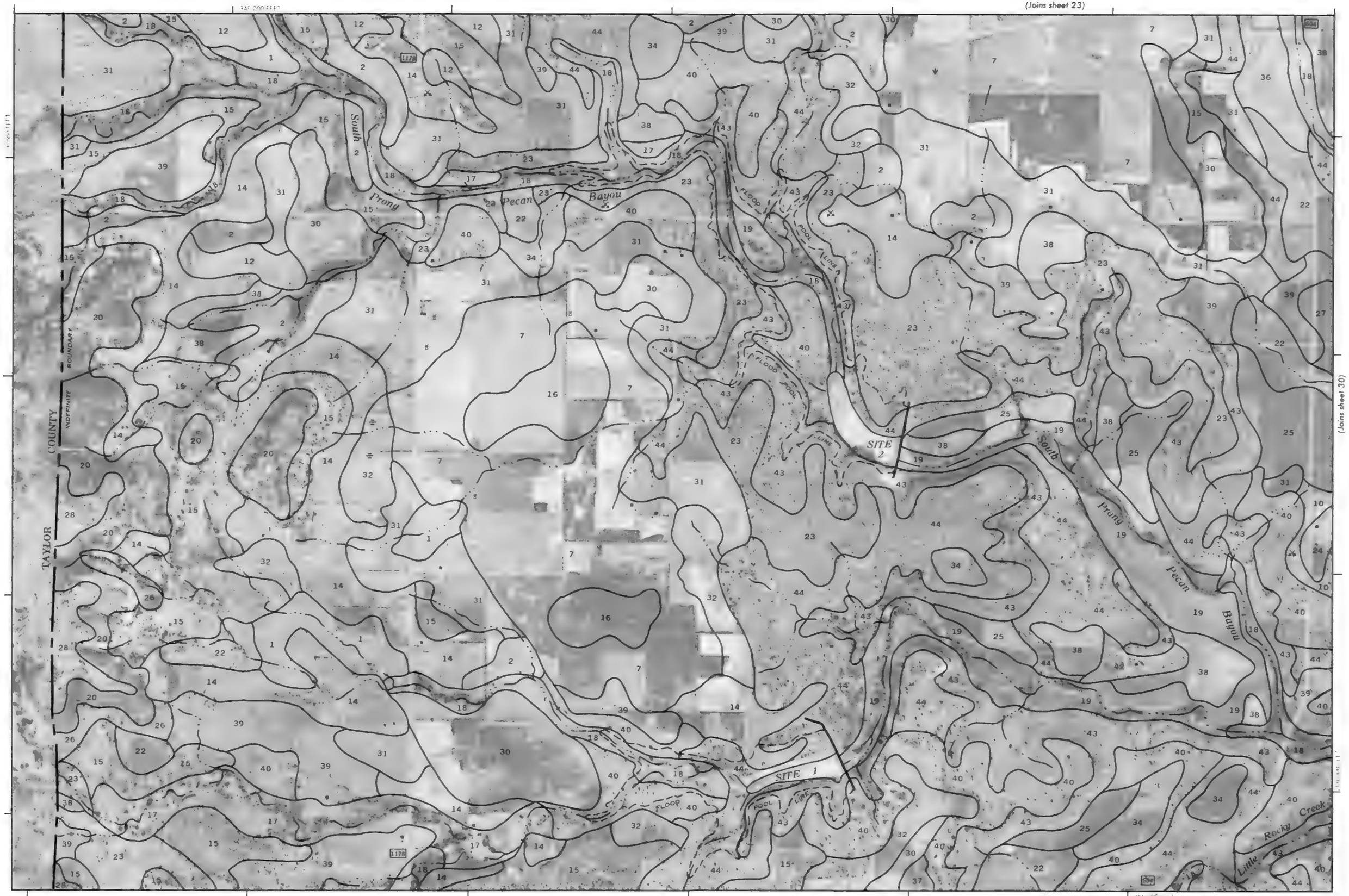
BOUNDARY

INDEFINITE

COUNTY

EASTLAND

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 29



CALLAHAN COUNTY, TEXAS — SHEET NUMBER 30

30

N

(Joins sheet 24)

1 395 000 FEET

2 Miles

10000 Feet

Scale 1:24000

5000

(Joins sheet 29)

Lick Branch

FLOOD POOL LINE

Pecan Bayou

South Prong

Pecan Bayou

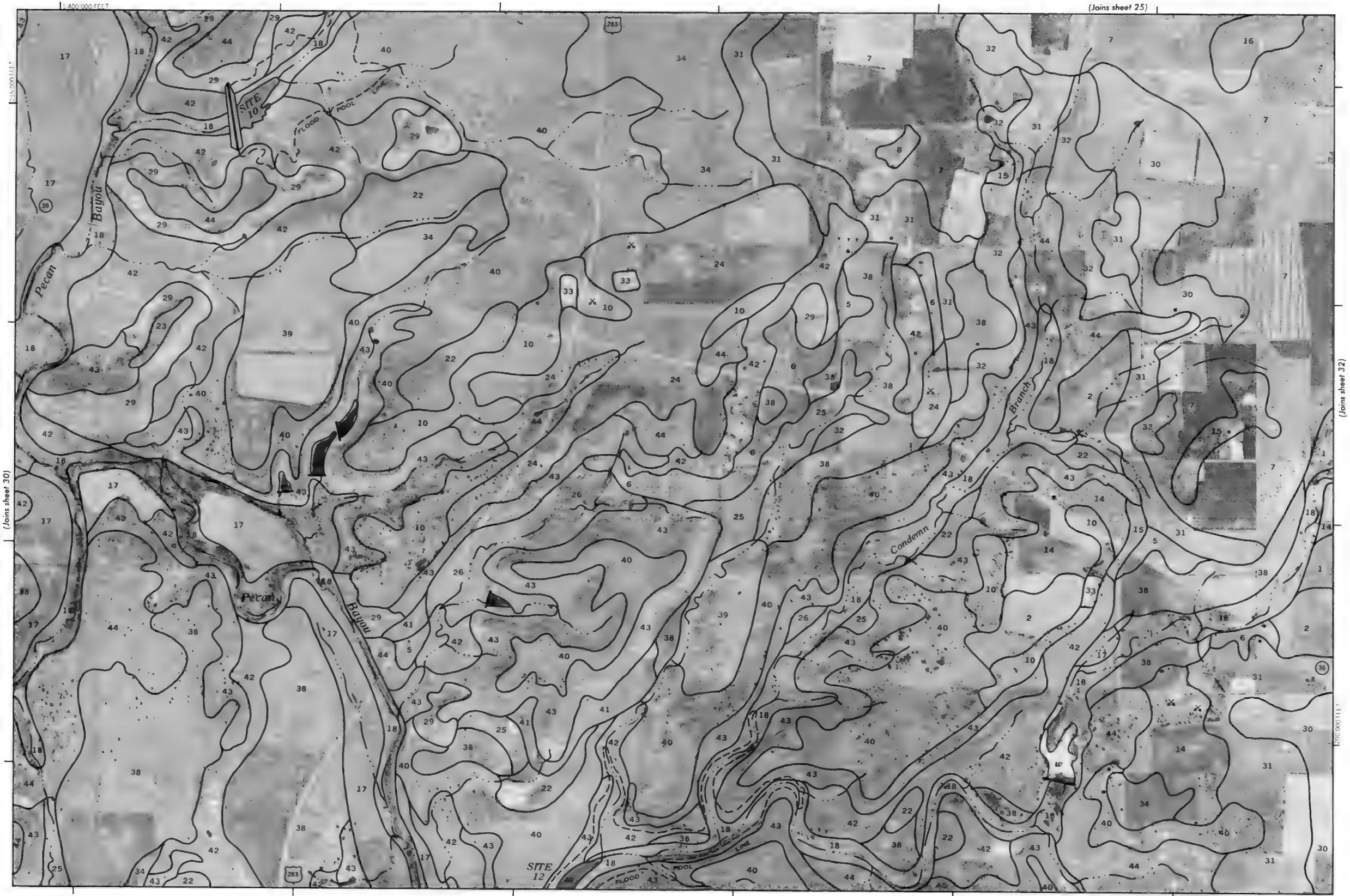
South Prong

1 370 000 FEET

(Joins sheet 35)

(Joins sheet 31)

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 31



31

N

2 Miles

10000 Feet

Scale 1:24000

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 32

(32)

N

(Joins sheet 26)

(Joins sheet 31)

(Joins sheet 33)

(Joins sheet 37)

Rowden

3146

Turkey Run

Walnut Creek

Burnt Branch

SITE 1A

2 Miles

10000 Feet

Scale 1:24000

1:24000

1:430,000 FEET

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 33

33

N

1 460 000 FEET

(Joins sheet 27)

(Joins sheet 32)

(Joins sheet 38)

1 485 000 FEET

215 000 FEET

200 000 FEET

SITE 1B

SITE 2

SITE 3

SITE 4

SITE 5

FLOOD POOL LINE

Cottonwood Creek

Turkey Creek

Cottonwood

2 Miles

1

0

Scale 1:24000

10000 Feet

5000

0

5000

4000

3000

2000

1000

0

N

2 Miles

10000 Feet

Scale 1:24000

(Joins sheet 29)

(Joins sheet 40)

(Joins sheet 35)

TAYLOR COUNTY

INDEFINITE BOUNDARY

Rocky Creek

Little Clear Creek

Camp Branch

Tecumseh Peak

Oplin

1178

604

2926

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 35

1 370 000 FEET

(Joins sheet 30)

1 395 000 FEET

(Joins sheet 34)

(Joins sheet 41)

Clear Creek

Clear Creek

35

N

2 Miles

10000 Feet

(Joins sheet 36)

Scale 1:24000

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 36

36

N

(Joins sheet 31)

(Joins sheet 35)

(Joins sheet 42)

(Joins sheet 37)

1 425 000 FEET

1 400 000 FEET

2 Miles 10000 Feet

Scale 1:24000

FLOOD POOL LINE

SITE 12

Pecan Bayou

Bear Branch

Clear Creek

283

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 37

37

N

1 430 000 FEET

(Joins sheet 32)

195 000 FEET

West Caddo Peak

Burnt Branch

West Prong Burnt Branch

Sand Branch

FLOOD POOL LINE

SITE 18A

(Joins sheet 36)

(Joins sheet 38)

(Joins sheet 43)

1 455 000 FEET

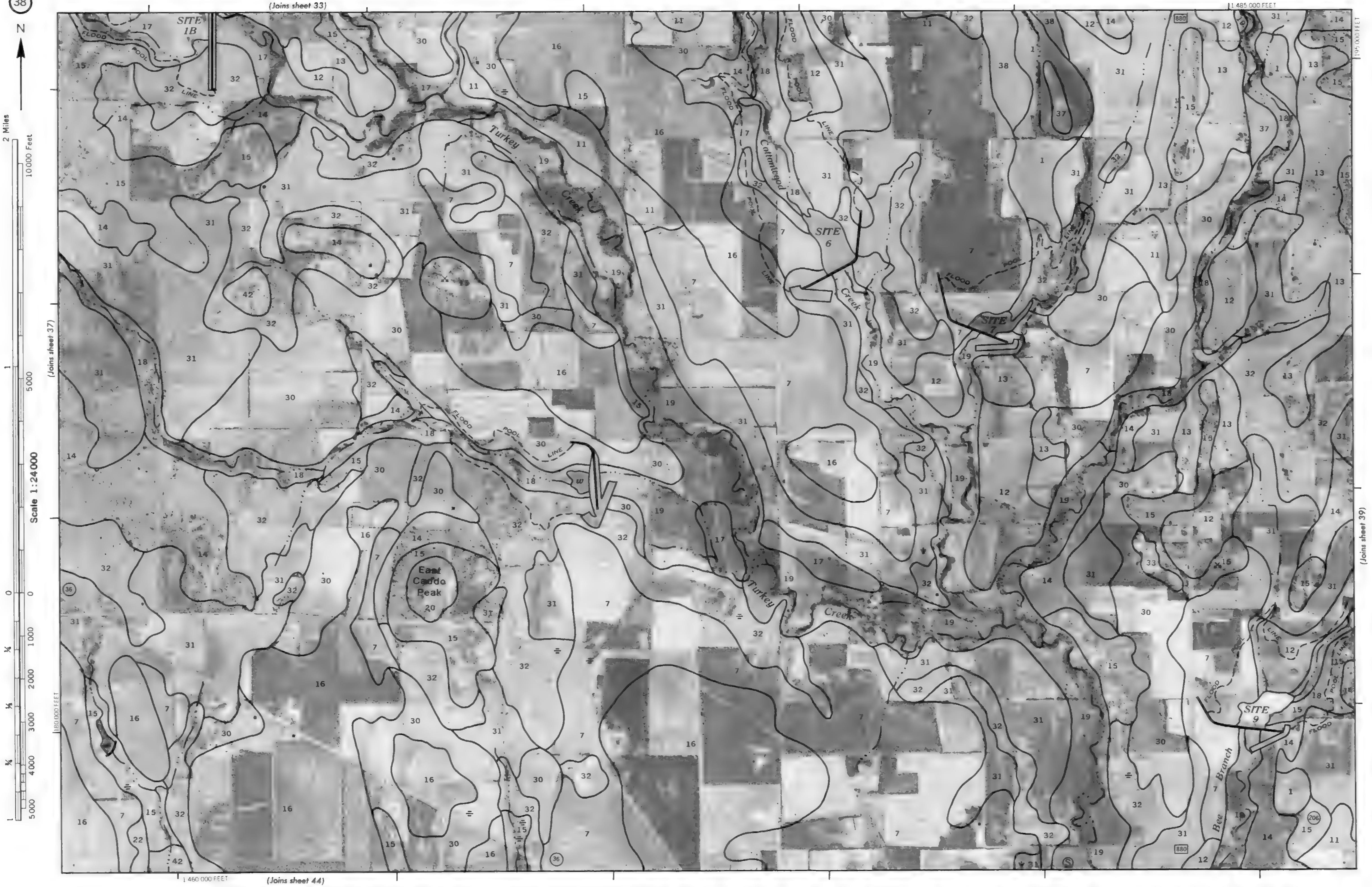
180 000 FEET

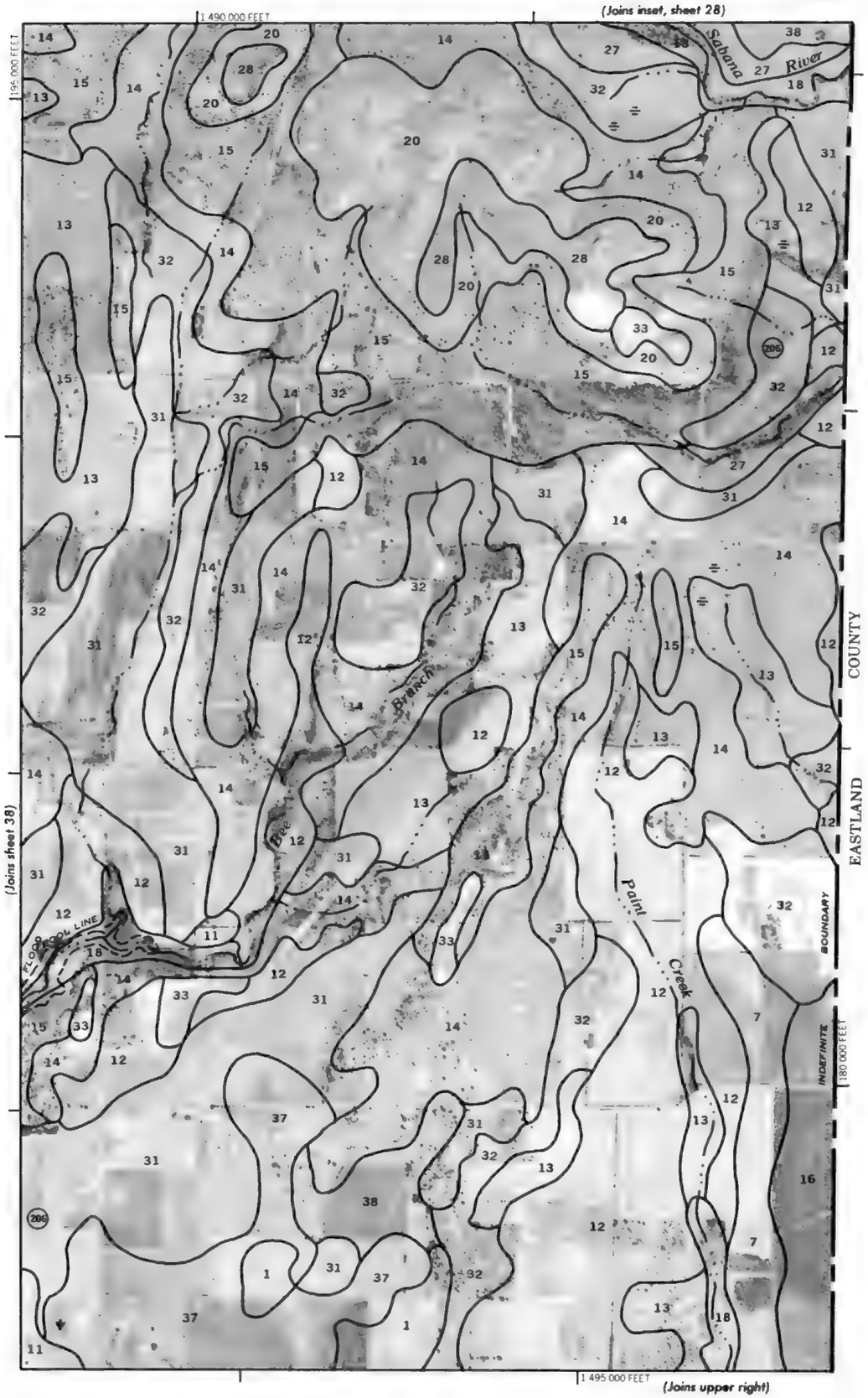
2 Miles

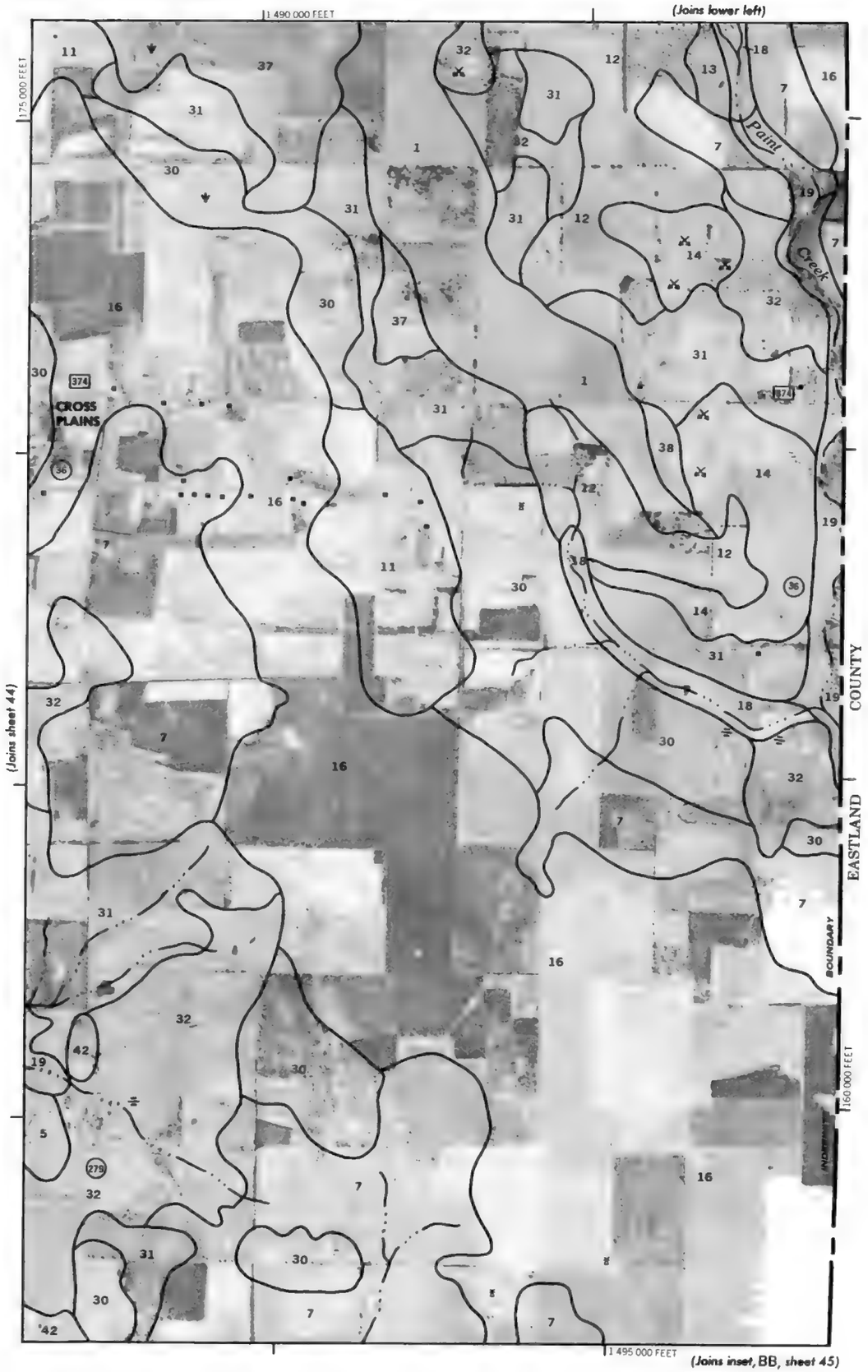
10000 Feet

Scale 1:24000

38


(Joins sheet 33)
(Joins sheet 37)
(Joins sheet 39)
(Joins sheet 44)
N
Scale 1:24 000
2 Miles
10 000 Feet
1 485 000 FEET
195 000 FEET
180 000 FEET
1 460 000 FEET
SITE 1B
SITE 6
SITE 7
SITE 9
FLOOD POOL LINE
Turkey Creek
Cottonwood Creek
Bee Branch
East Caddo Peak
880
206
36


1 490 000 FEET
(Joins inset, sheet 28)
1 495 000 FEET
(Joins upper right)
(Joins sheet 38)
Sabana River
Paint Creek
Bee Branch
FLOODWAY LINE
COUNTY
EASTLAND
BOUNDARY
INDEFINITE
180 000 FEET


1 490 000 FEET
(Joins lower left)
1 495 000 FEET
(Joins inset, BB, sheet 45)
(Joins sheet 44)
Paint Creek
CROSS PLAINS
COUNTY
EASTLAND
BOUNDARY
INDEFINITE
160 000 FEET


39
N
2 Miles
10000 Feet
Scale 1:24000
0
1000
2000
3000
4000
5000

40

N

(Joins sheet 34)

Camp Branch

Opdin

Clear Creek

Clear Creek

TAYLOR COUNTY BOUNDARY INDEFINITE

(Joins sheet 41)

(Joins sheet 45)

2 Miles 10000 Feet

1 5000

Scale 1:24000

0 0 1000 2000 3000 4000 5000

1 340 000 FEET

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 41

(Joins sheet 35)

(Joins sheet 40)

(Joins sheet 42)

(Joins inset A, sheet 45)

Crooked Creek

McEwen Draw

N

2 Miles

10000 Feet

Scale 1:24000

42

N

(Joins sheet 36)

1 425 000 FEET

(Joins sheet 43)

1 400 000 FEET

(Joins inset B, sheet 45)

(Joins sheet 41)

160 000 FEET

Clear Creek

Pecan Bayou

Mesquite Branch

Herd Branch

Crooked Creek

Pecan Bayou

283

2926

2926

Scale 1:24000

2 Miles 10000 Feet 5000 0 1000 2000 3000 4000 5000

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 43

1 430 000 FEET

(Joins sheet 37)

175 000 FEET

(Joins sheet 42)

(Joins sheet 44)

160 000 FEET

(Joins inset C, sheet 45)

1 455 000 FEET

SITE 18A

SITE 23

West Prong Burnt Branch

Burnt Branch

Sand Branch

Burnt Branch

Burnt Branch

Rocky Branch

Live Oak Branch

3146

2287

N

2 Miles

10000 Feet

Scale 1:24000

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 44

(44)

N

(Joins sheet 38)

1 485 000 FEET

1 475 000 FEET

(Joins sheet 43)

1 460 000 FEET

(Joins inset AA, sheet 45)

(Joins sheet 39)

Scale 1:24000

2 Miles 0 1 10000 Feet 0 1

5000 1000 2000 3000 4000 5000

1 0 1 2 3 4 5

160 000 FEET

SITE 21

SITE 22

FLOOD POOL LINE

Bayou

Pecan

Little

Dinner

Branch

Turkey Creek

CROSS PLAINS

CALLAHAN COUNTY, TEXAS — SHEET NUMBER 45